3.0 LOW-ACTIVITY WASTE FEED STAGING FOR CASE 3S6E

The Phase 1 privatization contract establishes specific requirements for the delivery of LAW feed to BNFL Inc. These requirements provide objectives for retrieval, staging and delivery of LAW waste. To meet these objectives, a staging scenario identified as Case 3S6E was evaluated by computer simulation. Case 3S6E represents the March 8, 2000, Planning Guidance (PIO 2000) and supersedes previous cases. Results and conclusions of the evaluation are discussed in this section. Summary of the LAW evaluations is discussed below.

Vitrification of LAW feed delivered through the last tank (241-AW-101) in the minimum order sequence is completed by September 2015, producing a total of 9,830 ILAW packages for Case 3S6E. If sulfate is removed, higher sodium oxide loading will occur, creating approximately 1,049 fewer ILAW packages. If the HLW wash solution and LAW portion from HLW were processed, the expected LAW glass would increase the duration by approximately nine months and increase the number of ILAW packages by approximately 915 compared to the baseline case. The minimum order tanks include 241-AP-101, LAW portion of 241-AZ-101/241-AZ-102, 241-AN-102, 241-AN-104, 241-AN-107, 241-AN-105, 241-SY-101, 241-AN-103, and 241-AW-101.

Case 3S6E is viable and provides a wider margin for CHG feed storage needs with no apparent cost penalty for the ORP. This case will lower the risk of idling the LAW vitrification facility by providing three staging tanks and one backup staging tank in the beginning.

The liquid fractions of Batches 2a, 2b, and 7 may not currently meet the criteria for Envelopes A, B, or C. Batches 2a and 2b were projected to be Envelope B feed but, because of high TRU, ^{90}Sr, and ^{60}Co concentrations in tank 241-AZ-101 and high SO_4, TRU, and ^{154}Eu concentrations in tank 241-AZ-102. These batches may not meet Envelope B specifications. The waste in tank 241-AN-107 (Batch 7) is not projected to meet the feed specification for its targeted envelope, Envelope C, because of high TRU and $^{154/155}$Eu. The second batch from 241-AN-104 is projected to meet the feed specifications. However, decanting the supernate from tank 241-AN-104 leaves settled solids that are high in sulfate. The diluted supernate will be returned and mixed multiple times with saltcake left in tank 241-AN-104 to ensure Envelope A feed is provided.

3.1 LOW-ACTIVITY WASTE STAGING SCENARIO

The staging approach for Case 3S6E is to provide reliable LAW feed delivery to BNFL Inc. while meeting privatization contract requirements. The number and location of staging tanks selected for Case 3S6E improve the reliability of LAW feed delivery by providing backup staged feed capability from independent tank farms. Feed staging capability is provided from AN and AP tank farms to minimize the probability of a single-point failure in the delivery system resulting in loss of feed capability.

Identification of LAW source and staging tanks for Case 3S6E Phase 1 is shown in Figure 3.1-1. Phase 1 LAW source tanks were specified by ORP (1999). Case 3S6E uses LAW from ten DSTs to meet the minimum order quantity of 6,000 units of LAW with some contingency. Waste from five DSTs and five SSTs provides LAW feed in the extended order of Phase 1 until February 2018.

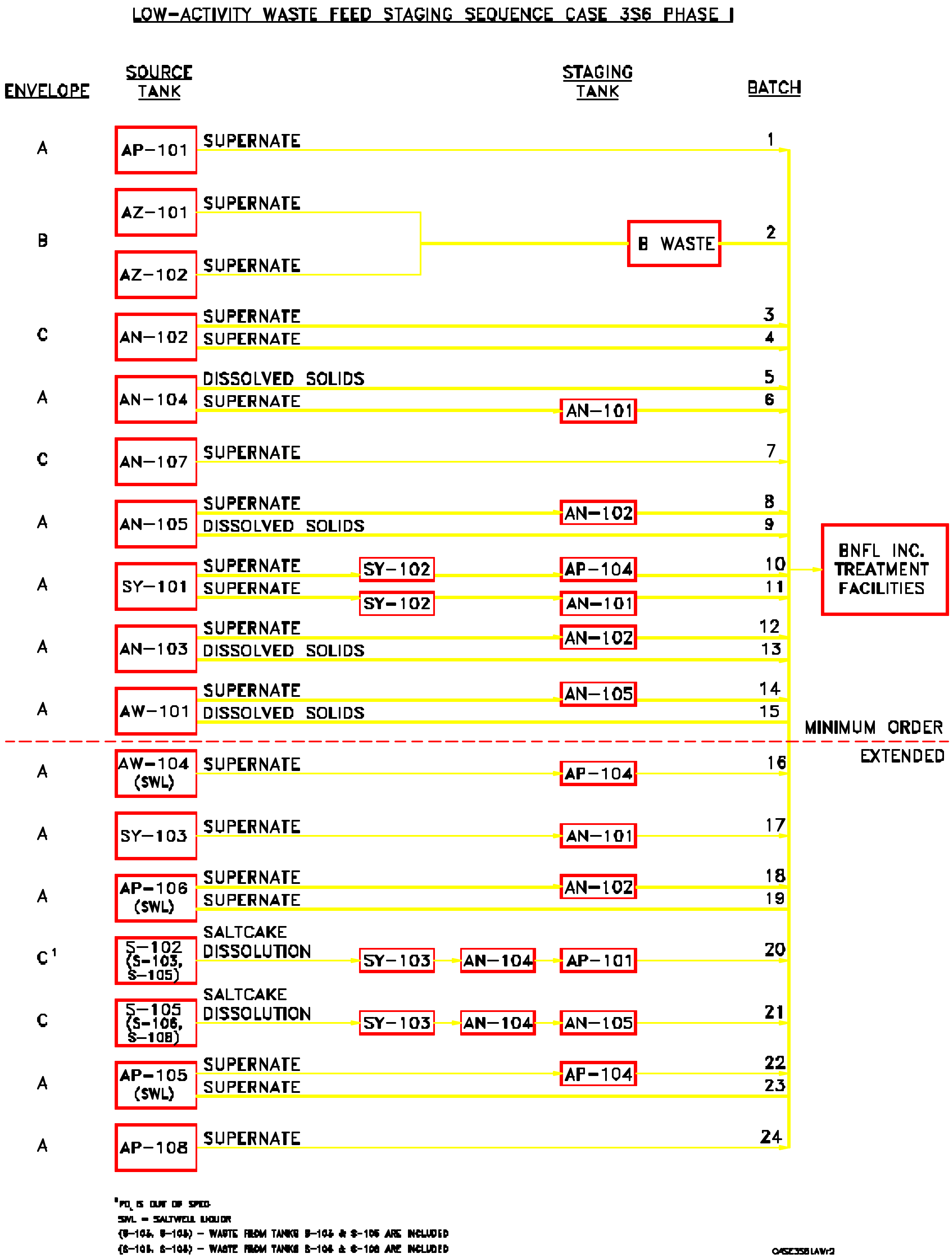
This case provides additional tank space for tank farm storage needs with no apparent cost penalty compared to previous cases. In addition, it provides a lower risk of idling the LAW vitrification facility by providing three staging tanks and one backup staging tank at the beginning of treatment services. This staging scenario uses tanks 241-AN-101, 241-AN-102 and 241-AP-104 as feed staging tanks as well as tank 241-AP-102 for backup staging tank. Other tanks will be used as staging tanks as they become available.

Tank 241-AN-105 and other tanks as they become available will be used as feed staging tanks as shown in Figure 3.1-1. Waste retrieved from most of the DSTs will be transferred to the staging tanks and certified before delivery to BNFL Inc.'s feed tank (ICD-19). Waste from tanks 241-AN-102 and 241-AN-107 will be certified before delivery to BNFL Inc.'s feed receipt tanks without going through a staging tank.

Feed delivered from each source tank is discussed in Section 3.1.1. Information on ILAW glass products is shown in Section 3.1.2. The composition of each feed batch is compared against contract specifications in Section 3.1.3.

The tank-specific staging plan, the retrieval and transfer equipment needed to support the staging plan, and the work execution schedule are discussed in Section 3.2. The waste transfers and certain precedent relationships directly needed to implement the LAW portion of the operating scenario are shown on the MSD in Section 3.2.3. Waste volume plots with denoted transfers as a function of time for all Phase 1 DSTs are also provided in Section 3.2.3. Major assumptions governing this staging scenario are discussed in Appendix A. A full description of all Phase 1 transfers including dates, volumes, and destinations is included in Appendix H.

Figure 3.1-1. Low-Activity Waste Fee Staging Diagram.



3.1.1 Low-Activity Waste Feed Delivery

The LAW portion of the staging scenario refers to the waste transfers and other operational activities needed to deliver LAW feed to BNFL Inc. Table 3.1-1 summarizes the operating scenario for Case 3S6E minimum order and extended order. For each batch of feed the table lists the units of feed, the envelope classification, and the nominal date on which CHG expects to deliver the feed.

The CHG Team will use tanks 241-AN-101, 241-AN-102, 241-AP-102, and 241-AP-104 for waste management during the same time frame that a project is preparing them for use as feed staging tanks. The details will change as waste management needs evolve and construction activities proceed. A detailed construction schedule that is to be prepared will accommodate the waste management activities.

Tanks 241-AN-103, -104, -105, and 241-AW-101 will be used as feed staging tanks after approximately half of the waste has been removed from each tank. For example, after approximately half the waste in tank 241-AN-105 has been removed to 241-AN-102 for staging, the remaining waste in tank 241-AN-105 will be diluted and certified. Once the waste in 241-AN-105 is removed, the tank will be used as a staging tank for other waste.

Figure 7.3-1 (Section 7.0) displays space that is not available for use in staging waste feed (e.g., head space in watch list tanks, spare tank space). This figure also shows the total volume of waste stored in the DST system as a function of time. Available tank space is improved by approximately 7,570 m^3 (2 Mgal) over previous DST volume projections. Projected waste volume does not exceed the tank space at any time even though it includes the planned 3,785 m^3 (1 Mgal) volume increase from retrieving and diluting tank 241-SY-101 waste to the mitigation of the crust level growth.

Case 3S6E offers an improved approach to management of tank space over previous cases. BNFL Inc.'s tanks (instead of tank 241-AP-106) are used for feed receipt, adding much needed tank space. Furthermore, Envelope B waste would not be returned to CHG. Entrained solids separated from LAW feed by BNFL also will be stored at the BNFL Inc. facility instead of returning to CHG. However, the capability to return entrained solids to the tank farms is retained in the transfer system.

Three sets of waste compositions, initial snapshot, final snapshot and staged feed, were compared to these limits and classified according to envelope (or classified as excluded if no envelope was satisfied). Waste with compositions that fell within 20 percent of any limit was further classified as borderline. The initial and final snapshot results are found in Appendix I. Additionally, Appendix E, Tables E1-2 through E1-9 compare the estimated composition of the retrieved liquid phase against the envelope limits on an analyte-by-analyte basis. These tables show which compositions satisfy the envelope limits and which are borderline cases.

Table 3.1-1. Summary of Low-Activity Waste Feed Staging and Delivery - Case 3S6E - R2A

Envelope[a]	Feed source	Staging tank	Batch	Dates[b]						Delivered LAW feed[d]						
				Start retrieval	Begin staging	Batch ready[c]	Start delivery	Start of vitrification	End of vitrification	Units of LAW delivered	Sodium delivered (MT)	Mass of LAW glass (MT)	Volume of LAW glass[e] (m^3)	Number of LAW packages[f]	Cumulative LAW packages[f]	Radioactivity[g] (Ci)
Privatization Phase 1 Minimum Order																
A	AP-101	none	1	--	--	7/29/05	4/29/06	11/30/06	4/26/08	615	615	4,272	1,606	711	711	1.88E+04
B	AZ-101	none	2a	--	--	--	7/8/07	4/26/08	9/20/09	1,308	503	9,080	3,414	1,511	2,222	3.92E+04
	AZ-102	none	2b	--	--	--	3/29/08									
C	AN-102	none	3	--	--	7/11/07	4/10/08	9/20/09	3/30/10	556	484	3,862	1,452	643	2,865	9.30E+04
		none	4	--	--	6/27/09	3/28/10	3/28/10	9/29/10	556	484	3,861	1,451	642	3,507	9.27E+04
A	AN-104[h]	none	5	12/2/04	9/1/08	12/29/09	9/29/10	9/29/10	2/22/11	439	439	3,045	1,145	507	4,014	7.35E+03
		AN-101	6	8/9/05	3/1/09	5/24/10	2/22/11	2/22/11	7/7/11	406	406	2,819	1,060	469	4,483	6.78E+03
C	AN-107	none	7	--	--	10/7/10	7/8/11	7/8/11	4/1/12	808	703	5,610	2,109	934	5,417	1.38E+05
A	AN-105	AN-102	8	3/30/10	4/2/10	7/2/11	4/1/12	4/1/12	8/21/12	425	425	2,948	1,108	491	5,907	2.20E+04
		none	9	--	--	11/21/11	8/21/12	8/21/12	1/6/13	414	414	2,872	1,080	478	6,385	1.61E+04
A	SY-101[i]	AP-104	10	11/15/99	1/15/00	4/7/12	1/6/13	1/6/13	4/15/13	298	298	2,070	778	344	6,730	1.64E+04
		AN-101	11	7/5/11	7/9/11	7/15/12	4/15/13	4/15/13	10/8/13	529	529	3,672	1,380	611	7,341	2.34E+04
A	AN-103	AN-102	12	4/3/12	4/8/12	1/7/13	10/8/13	10/8/13	4/6/14	542	542	3,760	1,414	626	7,967	1.03E+04
		none	13	--	--	7/6/13	4/6/14	4/6/14	10/4/14	542	542	3,765	1,416	627	8,593	9.80E+03
A	AW-101	AN-105	14	8/23/12	8/26/12	1/3/14	10/4/14	10/4/14	3/4/15	453	453	3,146	1,183	523	9,117	1.51E+04
		none	15	--	--	6/3/14	3/4/15	3/4/15	9/25/15	617	617	4,283	1,610	713	9,830	1.94E+04
Privatization Phase 1 Minimum Order (6,000 Units of LAW)										8,509	7,453					
Privatization Phase 1 Extended Order																
A	AW-104 (saltwell liquor)	AP-104	16	1/8/13	1/11/13	12/25/14	9/25/15	9/25/15	2/2/16	390	390	2,707	1,018	451	10,280	1.18E+04
A	SY-103	AN-101	17	5/1/13	5/3/13	5/4/15	2/2/16	2/2/16	4/28/16	258	258	1,791	673	298	10,578	8.07E+03
A	AP-106 (saltwell liquor)	AN-102	18	10/11/13	10/14/13	7/29/15	4/28/16	4/28/16	8/21/16	346	346	2,405	904	400	10,979	1.60E+04
		none	19	--	--	11/22/15	8/22/16	8/22/16	12/15/16	347	347	2,406	904	400	11,379	1.65E+04
C	S-102[j] (S-103, S-105)	AP-101	20	12/11/13	11/12/14	3/16/16	12/15/16	12/15/16	5/15/17	454	395	3,152	1,185	525	11,904	5.49E+04
C	S-105 (S-106, S-108)	AN-105	21	11/13/14	9/7/15	8/15/16	5/16/17	5/16/17	10/9/17	441	384	3,062	1,151	510	12,413	5.31E+04
A	AP-105	AP-104	22	9/28/15	10/2/15	1/8/17	10/9/17	10/9/17	2/25/18	417	417	2,897	1,089	482	12,895	1.38E+04
		none	23	--	--	5/28/17	2/26/18	2/26/18	7/15/18	418	418	2,901	1,091	483	13,378	1.37E+04
A	AP-108 (saltwell liquor)	none	24	--	--	10/14/17	7/15/18	7/15/18	3/26/19	765	765	5,311	1,997	884	14,262	5.06E+04
Privatization Phase 1 Extended Order										3,837	3,720					
Privatization Phase 1 Total										12,346	11,173					
DST Backfill for Phase 2[k]																
A	TX-112[l]		25	10/1/11	--	--	--	--	--	--	886	--	--	--	--	--
A	S-109[l]		26	9/8/15	--	--	--	--	--	--	624	--	--	--	--	--
A	S-112[l]		27	4/29/16	--	--	--	--	--	--	584	--	--	--	--	--
A	BY-112[l]		28	12/28/16	--	--	--	--	--	--	537	--	--	--	--	--
A	A-101[l]		29	3/11/18	--	--	--	--	--	--	954	--	--	--	--	--
A	BY-111[l]		30	9/12/18	--	--	--	--	--	--	657	--	--	--	--	--
A	AX-101[l]		31	10/28/18	--	--	--	--	--	--	839	--	--	--	--	--
Double-Shell Tank Backfill for Privatization Phase 2											5,081					
Privatization Phase 1 and Double-Shell Tank Backfill											16,254					

[a] Assumed envelope is based on current contract specifications and currently available characterization data.
[b] Dates are derived from the Mission Summary Diagram.
[c] The date where batch qualification has been completed and first batch of the batch group is ready to be delivered to BNFL.
[d] ILAW production based on sodium delivered from staged LAW feed.
e Glass density = 2.66 MT/m3
[f] 2.259 m^3 of LAW glass per package.
[g] Decayed to date of delivery.
[h] Decantation of the supernatant liquid from tank AN-104 leaves settled solids that are high in sulfate. Retrieval and mixing of all the waste in this tank as a slurry should alleviate the high sulfate problem. The diluted supernate will be returned and mixed multiple times with saltcake left in AN-104 to ensure Envelope A feed.
[i] The minimum order quantity is met midway through Batch 11.
[j] PO_4 is out of specification. Negotiate price with BNFL to process out-of-spec feed or find different feed.
[k] DST backfill list for Phase 2 is preliminary and subject to change.
[l] 100 percent of sodium assumed to be retrieved and delivered to the Phase 2 contractor. Retrieval efficiencies vary in other tanks.

The first set of compositions represents an initial snapshot of the targeted, as-retrieved fraction of waste projected to be present in the DSTs on October 1, 2004. For tanks with little or no metal oxide sludge, the entire tank contents were targeted for retrieval. For tanks with significant amounts of sludge, the sludge was excluded from retrieval. The initial snapshot was used to establish the processing sequence for Case 3S6E described in Section 3.2.1.

The amount of dilution water needed to retrieve the targeted waste fraction was determined as the amount of water needed to dilute the waste to reach a maximum liquid-phase sodium concentration limit for transfer. The maximum sodium concentration for the four DSTs containing Envelope A feed were selected to be roughly midway between the concentration at which no more solids dissolve and the concentration at which gibbsite begins to precipitate. This point was determined by computer model, using the Environmental Simulation Program (ESP)[1] package (see Section 3.3 for a discussion of solid-liquid equilibria). A matrix of 'wash-factors' that represents the end result of the solid-liquid equilibria calculations used by Hendrickson (1998) was used to repartition the liquid and solid components. The maximum sodium concentration for wastes was the proxy limit of 7.0*M*. The amount of dilution water added for each transfer is found in Appendix H.

3.1.2 Projected Low-Activity Waste Product

Three feed envelopes, entitled Envelope A, B, and C are established by the privatization contract (RL 1996). Each envelope provides a different technical challenge for BNFL Inc. Envelope A waste represents waste that will test the production capacity and fission-product removal efficiency of the plant and will produce a final product in which waste loading will be limited by sodium. Envelope B waste is similar to Envelope A, except that it was defined so that the waste loading in the final product will be limited by minor component concentrations. Working with a high-activity/high-heat waste composition, however, will challenge BNFL Inc. At least one of the Envelope A maximum limits for ^{90}Sr, ^{60}Co, ^{154}Eu, ^{155}Eu, or TRU must be exceeded for waste to be delivered as Envelope C.

Vitrification of LAW feed delivered through the last tank in the minimum order sequence, AW-101, is completed by September 2015, producing a total of 9,654 ILAW packages for Case 3S6E. This case represents a scenario with sodium oxide loadings of 0.195, 0.075, and 0.17 for Envelopes A, B, and C, respectively. The product contains 2.42 m^3 of glass in a 100 percent full package at a glass density of 2.66 MT/m^3. The minimum order tanks include 241-AP-101, 241-AZ-101/241-AZ-102 supernate mixture, 241-AN-102, 241-AN-104, 241-AN-107, 241-AN-105, 241-SY-101, 241-AN-103, and 241-AW-101.

3.1.3 Feed Compliance With Contract Specifications

The LAW feeds will contain liquids that must meet the criteria set forth in Section C, Specification 7, of the contract for Envelope A, B, or C waste feed (RL 1996). The analytical and radiological concentration limits from Specification 7 and the predicted compositions for the

[1] ESP is a trademark of OLI Systems, Inc.

24 batches delivered in Phase 1 are presented in Tables 3.1-2 and 3.1-3. The concentration of sodium is presented as well.

In Tables 3.1-2 and 3.1-3, the concentration of a component is compared to the maximum concentration allowed for that component for Envelopes A, B, and C for the minimum order and extended order feed batches, respectively. There are three columns that follow the concentration data from each batch group that correspond to the three envelopes. If the concentration for a component meets the criteria for an envelope, a "Y" is indicated in the cell of the table. Conversely, if the specification limit is not met, a "N" is placed in the cell and the background of the cell is shaded to call attention to it. A shaded cell background with “5” identifies components within 50 percent of a specification and a shaded cell background with “8” identifies components within 80 percent of a specification

Concentration data represented by zero values may be due to engineering assessments of sample data. The sample data may have been reported as "less-than" values or may not have been reported at all. The concentration data pedigree is addressed in Appendix B. The radionuclide data presented are decayed to the time of feed delivery to reflect what is spelled out in Specification 7 of the contract.

Table 3.1-2 shows that the liquid fractions of Batches 2a, 2b, and 7 do not meet the criteria for Envelopes A, B, or C. Batches 2a and 2b were intended to be Envelope B feed. Batch 2a may be out of specification in TRU, ^{90}Sr, and ^{60}Co. Batch 2b may be out of specification in SO_4, TRU, and ^{154}Eu and ^{155} Eu. Batch 7 may be out of specification in TRU and ^{154}Eu and ^{155}Eu. During the certification process, the analysis should be performed to verify whether these batches do meet the feed specification. If the waste is out-of-specification and treatable within the facility, a price for processing the out of specification feed will be negotiated (RL 1996).

Table 3.1-2. The Low-Activity Waste Feeds Minimum Order – Case 3S6E.

From Tables TS-7.1 and TS-7.2 of Contract			
Chemical Analyte	Envelope A	Envelope B	Envelope C
	moles of analyte to moles of sodium		
Al	2.5E-01	2.5E-01	2.5E-01
Ba	1.0E-04	1.0E-04	1.0E-04
Ca	4.0E-02	4.0E-02	4.0E-02
Cd	4.0E-03	4.0E-03	4.0E-03
Cl	3.7E-02	8.9E-02	3.7E-02
Cr	6.9E-03	2.0E-02	6.9E-03
F	9.1E-02	2.0E-01	9.1E-02
Fe	1.0E-02	1.0E-02	1.0E-02
Hg	1.4E-05	1.4E-05	1.4E-05
K	1.8E-01	1.8E-01	1.8E-01
La	8.3E-05	8.3E-05	8.3E-05
Ni	3.0E-03	3.0E-03	3.0E-03
NO2	3.8E-01	3.8E-01	3.8E-01
NO3	8.0E-01	8.0E-01	8.0E-01
Pb	6.8E-04	6.8E-04	6.8E-04
PO4	3.8E-02	1.3E-01	3.8E-02
SO4	1.0E-02	7.0E-02	2.0E-02
TIC	3.0E-01	3.0E-01	3.0E-01
TOC	5.0E-01	5.0E-01	5.0E-01
U	1.2E-03	1.2E-03	1.2E-03
Radionuclide	Becquerels of radionuclide to moles of sodium		
TRU	4.8E+05	4.8E+05	3.0E+06
^{137}Cs	4.3E+09	2.0E+10	4.3E+09
^{90}Sr	4.4E+07	4.4E+07	8.0E+08
^{99}Tc	7.1E+06	7.1E+06	7.1E+06
^{60}Co	6.1E+04	6.1E+04	3.7E+05
^{154}Eu + ^{155}Eu	1.2E+06	1.2E+06	4.3E+06
From Spec 7.2.2.1	mol/L		
Na	3 to 10		

Chemical Analyte	AP-101				AZ-101				AZ-102			
	LAW-1	A	B	C	LAW-2a	A	B	C	LAW-2b	A	B	C
Al	5.63E-02				8.41E-02				2.34E-02			
Ba	4.11E-07				4.09E-06				1.31E-13			
Ca	1.52E-04				2.54E-06				4.66E-05			
Cd	1.46E-06				8.72E-06				2.80E-13			
Cl	5.84E-03				1.17E-03				1.11E-04			
Cr	3.27E-04				3.10E-03				8.11E-03	N		N
F	1.90E-02				2.06E-02				2.32E-02			
Fe	1.09E-05				4.18E-05				8.01E-05			
Hg	0.00E+00				0.00E+00				0.00E+00			
K	7.20E-02				2.50E-02				3.36E-02			
La	0.00E+00				4.67E-11				8.26E-06			
Ni	1.69E-05				1.85E-07				1.51E-05			
NO2	1.38E-01				2.96E-01	5	5	5	2.78E-01	5	5	5
NO3	3.34E-01				2.55E-01				1.58E-01			
Pb	2.39E-06				0.00E+00				0.00E+00			
PO4	1.64E-03				3.22E-03				5.96E-04			
SO4	5.61E-03	5			3.93E-02	N	5	N	7.92E-02	N	N	N
TIC	3.66E-02				1.18E-01				2.44E-01	8	8	8
TOC	4.13E-02				2.49E-02				5.56E-02			
U	1.68E-05				4.46E-06				2.72E-04			
Radionuclide												
TRU	7.92E+03				2.14E+06	N	N	5	3.29E+06	N	N	N
^{137}Cs	7.58E+08				1.23E+10	N	5	N	1.33E+10	N	5	N
^{90}Sr	5.86E+05				2.83E+08	N	N		3.13E+06			
^{99}Tc	4.56E+05				2.32E+06				2.74E+06			
^{60}Co	3.80E+03				1.58E+05	N	N		3.17E+02			
^{154}Eu + ^{155}Eu	2.00E+05				1.10E+01				1.57E+06	N	N	
From Spec 7.2.2.1												
Na	6.51				2.36	N	N	N	1.48	N	N	N
		A					B				B	
Overall:		Y	Y	Y		N	N	N		N	N	N
N's		0	0	0		6	4	3		6	4	5
>80%		0	0	0		6	4	3		7	5	6
>50%		1	0	0		7	7	5		8	7	7

Chemical Analyte	AN-102							
	LAW-3	A	B	C	LAW-4	A	B	C
Al	5.16E-02				5.16E-02			
Ba	2.01E-05				2.01E-05			
Ca	1.39E-03				1.39E-03			
Cd	5.20E-05				5.20E-05			
Cl	9.65E-03				9.65E-03			
Cr	7.28E-04				7.28E-04			
F	8.73E-03				8.73E-03			
Fe	3.51E-04				3.51E-04			
Hg	0.00E+00				0.00E+00			
K	8.85E-03				8.85E-03			
La	0.00E+00				0.00E+00			
Ni	6.17E-04				6.17E-04			
NO2	1.60E-01				1.60E-01			
NO3	3.25E-01				3.25E-01			
Pb	8.64E-05				8.63E-05			
PO4	4.60E-03				4.60E-03			
SO4	1.47E-02	N		5	1.47E-02	N		5
TIC	1.03E-01				1.03E-01			
TOC	1.98E-01				1.98E-01			
U	6.84E-05				6.84E-05			
Radionuclide								
TRU	7.10E+05	N	N		7.03E+05	N	N	
^{137}Cs	8.80E+08				8.38E+08			
^{90}Sr	2.16E+08	N	N		1.94E+08	N	N	
^{99}Tc	7.15E+05				7.16E+05			
^{60}Co	9.46E+04	N	N		7.34E+04	N	N	
^{154}Eu + ^{155}Eu	6.27E+05	5	5		5.22E+05			
From Spec 7.2.2.1								
Na	9.00				9.00			
				C				C
Overall:		N	N	Y		N	N	Y
N's		4	3	0		4	3	0
>80%		4	3	0		4	3	0
>50%		5	4	1		4	3	1

Chemical Analyte	AN-104								AN-107			
	LAW-5	A	B	C	LAW-6	A	B	C	LAW-7	A	B	C
									moles of analyte to moles of sodium			
Al	1.13E-01				1.15E-01				2.79E-02			
Ba	1.19E-05				1.27E-05				0.00E+00			
Ca	9.56E-05				9.97E-05				1.55E-03			
Cd	1.47E-06				1.53E-06				0.00E+00			
Cl	2.07E-02	5		5	2.07E-02	5		5	5.73E-03			
Cr	5.19E-04				5.25E-04				6.35E-04			
F	2.94E-03				2.68E-03				1.93E-02			
Fe	3.23E-05				3.40E-05				5.46E-03	5	5	5
Hg	0.00E+00				0.00E+00				1.96E-07			
K	1.22E-02				1.25E-02				4.56E-03			
La	1.21E-06				1.30E-06				2.71E-05			
Ni	1.23E-05				1.30E-05				9.13E-04			
NO2	2.38E-01	5	5	5	2.39E-01	5	5	5	1.43E-01			
NO3	2.75E-01				2.72E-01				3.80E-01			
Pb	1.88E-05				1.96E-05				2.09E-04			
PO4	4.13E-03				3.97E-03				4.19E-03			
SO4	9.69E-03	8			9.02E-03	8			9.64E-03	8		
TIC	7.87E-02				7.21E-02				1.35E-01			
TOC	2.43E-02				2.42E-02				3.46E-01	5	5	5
U	6.08E-06				5.65E-06				6.38E-05			
Radionuclide									Becquerels of radionuclide to moles of sodium			
TRU	9.29E+03				8.99E+03				3.48E+06	N	N	N
^{137}Cs	1.39E+09				1.40E+09				1.01E+09			
^{90}Sr	3.84E+05				3.64E+05				3.71E+08	N	N	
^{99}Tc	9.49E+05				9.55E+05				5.02E+05			
^{60}Co	1.31E+04				1.32E+04				1.22E+05	N	N	
^{154}Eu + ^{155}Eu	1.30E+05				1.32E+05				4.53E+06	N	N	N
From Spec 7.2.2.1									mol/L			
Na	6.89				6.88				8.45			
		A				A						C
Overall:		Y	Y	Y		Y	Y	Y		N	N	N
N's		0	0	0		0	0	0		4	4	2
>80%		1	0	0		1	0	0		5	4	2
>50%		3	1	2		3	1	2		7	6	4

Chemical Analyte	AN-105							
	LAW-8	A	B	C	LAW-9	A	B	C
Al	1.27E-01	5	5	5	9.02E-02			
Ba	1.82E-05				8.28E-06			
Ca	2.13E-04				2.10E-04			
Cd	4.93E-06				8.33E-07			
Cl	2.50E-02	5		5	2.55E-02	5		5
Cr	4.65E-04				6.50E-04			
F	3.31E-03				8.92E-03			
Fe	5.65E-05				1.85E-05			
Hg	0.00E+00				0.00E+00			
K	1.45E-02				1.21E-02			
La	6.26E-14				3.41E-13			
Ni	5.33E-05				1.56E-05			
NO2	2.40E-01	5	5	5	2.42E-01	5	5	5
NO3	2.56E-01				2.82E-01			
Pb	2.65E-05				1.44E-05			
PO4	2.17E-03				5.34E-03			
SO4	4.35E-03				7.33E-03	5		
TIC	4.04E-02				1.09E-01			
TOC	5.63E-02				4.53E-02			
U	5.51E-06				8.96E-07			
Radionuclide								
TRU	4.47E+04				1.60E+03			
^{137}Cs	9.55E+08				9.80E+08			
^{90}Sr	1.38E+07				9.59E+06			
^{99}Tc	1.42E+06				1.50E+06			
^{60}Co	6.71E+03				3.19E+03			
^{154}Eu + ^{155}Eu	4.35E+04				7.80E+03			
From Spec 7.2.2.1								
Na	6.93				7.00			
		A				A		
Overall:		Y	Y	Y		Y	Y	Y
N's		0	0	0		0	0	0
>80%		0	0	0		0	0	0
>50%		3	2	3		3	1	2

Chemical Analyte	SY-101							
	LAW-10	A	B	C	LAW-11	A	B	C
Al	9.83E-02				9.28E-02			
Ba	0.00E+00				3.91E-07			
Ca	3.27E-04				4.43E-04			
Cd	0.00E+00				4.35E-08			
Cl	2.80E-02	5		5	2.73E-02	5		5
Cr	4.55E-03	5		5	5.23E-03	5		5
F	5.00E-03				6.20E-03			
Fe	3.48E-04				6.18E-04			
Hg	2.34E-08				4.36E-09			
K	8.41E-03				8.29E-03			
La	4.09E-06				4.35E-08			
Ni	1.68E-04				2.92E-04			
NO2	2.63E-01	5	5	5	2.77E-01	5	5	5
NO3	2.87E-01				2.40E-01			
Pb	3.03E-04				3.47E-05			
PO4	8.73E-03				7.29E-03			
SO4	7.47E-03	5			4.80E-03			
TIC	5.58E-02				7.22E-02			
TOC	6.19E-02				8.82E-02			
U	1.49E-05				8.57E-06			
Radionuclide								
TRU	2.82E+05	5	5		1.41E+04			
^{137}Cs	8.16E+08				8.24E+08			
^{90}Sr	1.01E+07				1.18E+07			
^{99}Tc	1.81E+06				1.25E+06			
^{60}Co	3.07E+03				1.53E+03			
^{154}Eu + ^{155}Eu	1.59E+05				4.65E+03			
From Spec 7.2.2.1								
Na	4.59				6.83			
		A				A		
Overall:		Y	Y	Y		Y	Y	Y
N's		0	0	0		0	0	0
>80%		0	0	0		0	0	0
>50%		5	2	3		3	1	3

Chemical Analyte	AN-103							
	LAW-12	A	B	C	LAW-13	A	B	C
Al	1.50E-01	5	5	5	1.51E-01	5	5	5
Ba	1.12E-05				1.09E-05			
Ca	6.72E-05				6.28E-05			
Cd	1.91E-06				1.82E-06			
Cl	1.73E-02				1.70E-02			
Cr	7.21E-04				7.29E-04			
F	3.70E-03				3.71E-03			
Fe	1.92E-05				1.81E-05			
Hg	0.00E+00				0.00E+00			
K	2.47E-02				2.50E-02			
La	3.40E-07				3.81E-07			
Ni	8.36E-06				6.99E-06			
NO2	2.26E-01	5	5	5	2.25E-01	5	5	5
NO3	2.45E-01				2.45E-01			
Pb	2.33E-05				2.33E-05			
PO4	1.88E-03				1.87E-03			
SO4	2.28E-03				2.22E-03			
TIC	3.23E-02				3.21E-02			
TOC	1.36E-02				1.23E-02			
U	1.20E-06				1.07E-06			
Radionuclide								
TRU	2.39E+04				2.33E+04			
^{137}Cs	1.07E+09				1.07E+09			
^{90}Sr	1.36E+06				9.88E+05			
^{99}Tc	8.09E+05				7.88E+05			
^{60}Co	6.97E+03				6.57E+03			
^{154}Eu + ^{155}Eu	5.70E+04				5.42E+04			
From Spec 7.2.2.1								
Na	6.75				6.70			
		A				A		
Overall:		Y	Y	Y		Y	Y	Y
N's		0	0	0		0	0	0
>80%		0	0	0		0	0	0
>50%		2	2	2		2	2	2

Chemical Analyte	AW-101							
	LAW-14	A	B	C	LAW-15	A	B	C
Al	9.75E-02				1.00E-01			
Ba	2.08E-06				0.00E+00			
Ca	1.81E-04				1.72E-04			
Cd	2.03E-07				0.00E+00			
Cl	1.68E-02				1.39E-02			
Cr	3.62E-04				2.64E-04			
F	8.14E-03				7.88E-03			
Fe	4.69E-05				5.66E-05			
Hg	0.00E+00				0.00E+00			
K	6.38E-02				8.14E-02			
La	9.52E-13				1.16E-12			
Ni	2.00E-05				2.16E-05			
NO2	2.13E-01	5	5	5	2.03E-01	5	5	5
NO3	2.65E-01				2.59E-01			
Pb	2.76E-05				3.21E-05			
PO4	2.20E-03				1.13E-03			
SO4	3.44E-03				2.12E-03			
TIC	5.06E-02				3.07E-02			
TOC	2.95E-02				2.41E-02			
U	5.90E-05				7.88E-05			
Radionuclide								
TRU	1.24E+04				1.57E+04			
^{137}Cs	1.01E+09				1.00E+09			
^{90}Sr	7.02E+06				6.25E+06			
^{99}Tc	1.08E+06				9.41E+05			
^{60}Co	3.24E+03				3.33E+03			
^{154}Eu + ^{155}Eu	5.96E+04				7.38E+04			
From Spec 7.2.2.1								
Na	6.99				7.00			
		A				A		
Overall:		Y	Y	Y		Y	Y	Y
N's		0	0	0		0	0	0
>80%		0	0	0		0	0	0
>50%		1	1	1		1	1	1

Table 3.1-3. The Low-Activity Waste Feeds Extendeed Order - Case 3S6E

From Tables TS-7.1 and TS-7.2 of Contract				AW-104				SY-103				AP-106			
Chemical Analyte	Envelope A	Envelope B	Envelope C	LAW-16	A	B	C	LAW-17	A	B	C	LAW-18	A	B	C
	moles of analyte to moles of sodium			moles of analyte to moles of sodium											
Al	2.5E-01	2.5E-01	2.5E-01	1.03E-01				9.45E-02				8.91E-02			
Ba	1.0E-04	1.0E-04	1.0E-04	4.59E-08				2.28E-08				5.97E-07			
Ca	4.0E-02	4.0E-02	4.0E-02	3.17E-04				2.23E-04				1.70E-04			
Cd	4.0E-03	4.0E-03	4.0E-03	3.27E-08				2.78E-09				1.33E-07			
Cl	3.7E-02	8.9E-02	3.7E-02	1.87E-02	5		5	3.50E-02	8		8	2.03E-02	5		5
Cr	6.9E-03	2.0E-02	6.9E-03	2.43E-03				1.09E-03				3.16E-03			
F	9.1E-02	2.0E-01	9.1E-02	4.85E-02	5		5	6.88E-03				9.69E-03			
Fe	1.0E-02	1.0E-02	1.0E-02	9.04E-05				6.05E-05				9.86E-05			
Hg	1.4E-05	1.4E-05	1.4E-05	9.24E-09				2.60E-10				9.35E-09			
K	1.8E-01	1.8E-01	1.8E-01	1.64E-02				1.04E-02				2.52E-02			
La	8.3E-05	8.3E-05	8.3E-05	2.53E-06				3.56E-09				5.44E-06			
Ni	3.0E-03	3.0E-03	3.0E-03	5.72E-05				7.95E-05				6.73E-05			
NO2	3.8E-01	3.8E-01	3.8E-01	2.10E-01	5	5	5	3.23E-01	8	8	8	2.17E-01	5	5	5
NO3	8.0E-01	8.0E-01	8.0E-01	2.56E-01				3.20E-01				3.34E-01			
Pb	6.8E-04	6.8E-04	6.8E-04	1.04E-04				2.68E-05				2.45E-04			
PO4	3.8E-02	1.3E-01	3.8E-02	3.90E-03				1.45E-02				6.94E-03			
SO4	1.0E-02	7.0E-02	2.0E-02	7.65E-03	5			6.68E-03	5			9.23E-03	8		
TIC	3.0E-01	3.0E-01	3.0E-01	8.72E-02				6.35E-02				8.14E-02			
TOC	5.0E-01	5.0E-01	5.0E-01	5.17E-02				1.06E-01				3.66E-02			
U	1.2E-03	1.2E-03	1.2E-03	2.28E-04				7.00E-06				2.52E-05			
Radionuclide	Becquerels of radionuclide to moles of sodium			Becquerels of radionuclide to moles of sodium											
TRU	4.8E+05	4.8E+05	3.0E+06	2.16E+05				2.47E+04				2.52E+05	5	5	
137Cs	4.3E+09	2.0E+10	4.3E+09	5.46E+08				9.82E+08				7.02E+08			
90Sr	4.4E+07	4.4E+07	8.0E+08	3.69E+06				6.52E+06				4.10E+06			
99Tc	7.1E+06	7.1E+06	7.1E+06	7.98E+05				1.39E+06				8.53E+05			
60Co	6.1E+04	6.1E+04	3.7E+05	1.02E+03				5.25E+03				7.06E+03			
154Eu + 155Eu	1.2E+06	1.2E+06	4.3E+06	4.37E+04				2.07E+02				1.14E+05			
From Spec 7.2.2.1	mol/L			mol/L											
Na	3 to 10			6.75				6.98				6.99			
					A				A				A		
					Y	Y	Y		Y	Y	Y		Y	Y	Y
					0	0	0		0	0	0		0	0	0
					0	0	0		2	1	2		1	0	0
					4	1	3		3	1	2		4	2	2

	AP-106				S-102				S-105			
Chemical Analyte	LAW-19	A	B	C	LAW-20	A	B	C	LAW-21	A	B	C
	moles of analyte to moles of sodium											
Al	8.62E-02				5.57E-02				7.18E-02			
Ba	6.63E-08				1.68E-08				5.39E-07			
Ca	1.75E-04				2.92E-04				1.08E-04			
Cd	6.63E-08				5.03E-08				5.39E-08			
Cl	2.05E-02	5		5	1.71E-02				1.24E-02			
Cr	3.28E-03				2.33E-03				4.27E-03	5		5
F	9.98E-03				2.29E-02				2.21E-02			
Fe	1.02E-04				5.62E-05				1.73E-05			
Hg	9.80E-09				1.53E-10				3.87E-08			
K	2.52E-02				6.95E-03				1.84E-02			
La	5.64E-06				2.33E-07				1.97E-08			
Ni	7.02E-05				2.24E-05				6.35E-06			
NO2	2.17E-01	5	5	5	1.59E-01				1.34E-01			
NO3	3.39E-01				4.60E-01	5	5	5	4.37E-01	5	5	5
Pb	2.56E-04				6.35E-06				7.37E-06			
PO4	7.18E-03				3.90E-02	N		N	2.72E-02	5		5
SO4	9.57E-03	8			1.23E-02	N		5	1.10E-02	N		5
TIC	8.38E-02				3.60E-02				4.33E-02			
TOC	3.77E-02				4.18E-02				2.37E-02			
U	2.63E-05				1.17E-05				2.09E-05			
Radionuclide	Becquerels of radionuclide to moles of sodium											
TRU	2.63E+05	5	5		1.79E+04				6.83E+03			
137Cs	7.02E+08				4.62E+08				4.49E+08			
90Sr	4.20E+06				5.29E+07	N	N		5.44E+07	N	N	
99Tc	8.60E+05				7.38E+05				6.74E+05			
60Co	6.87E+03				1.32E+03				6.31E+02			
154Eu + 155Eu	1.14E+05				5.71E+03				1.17E+04			
From Spec 7.2.2.1	mol/L											
Na	6.99				4.58				4.63			
		A						C				C
		Y	Y	Y		N	N	N		N	N	Y
		0	0	0		3	1	1		2	1	0
		1	0	0		3	1	1		2	1	0
		4	2	2		4	2	3		5	2	4

	AP-105								AP-108			
Chemical Analyte	LAW-22	A	B	C	LAW-23	A	B	C	LAW-24	A	B	C
	moles of analyte to moles of sodium											
Al	1.13E-01				1.14E-01				1.42E-01	5	5	5
Ba	2.05E-08				1.95E-08				2.70E-07			
Ca	1.59E-04				1.53E-04				1.38E-04			
Cd	1.46E-08				1.39E-08				1.80E-07			
Cl	2.18E-02	5		5	2.19E-02	5		5	2.34E-02	5		5
Cr	1.69E-03				1.66E-03				2.44E-03			
F	2.86E-02				2.79E-02				4.56E-03			
Fe	5.64E-05				5.51E-05				5.81E-05			
Hg	2.51E-08				2.57E-08				9.01E-08			
K	2.87E-02				2.92E-02				1.56E-02			
La	1.16E-06				1.10E-06				1.71E-06			
Ni	3.74E-05				3.66E-05				5.98E-05			
NO2	2.81E-01	5	5	5	2.84E-01	5	5	5	2.70E-01	5	5	5
NO3	4.35E-01	5	5	5	4.41E-01	5	5	5	2.78E-01			
Pb	3.95E-05				3.71E-05				5.08E-05			
PO4	4.24E-03				4.26E-03				5.69E-03			
SO4	7.75E-03	5			7.75E-03	5			6.13E-03	5		
TIC	5.25E-02				5.12E-02				3.55E-02			
TOC	3.15E-02				3.07E-02				3.89E-02			
U	4.49E-05				3.79E-05				3.33E-04			
Radionuclide	Becquerels of radionuclide to moles of sodium											
TRU	3.37E+04				2.68E+04				1.40E+05			
137Cs	5.59E+08				5.58E+08				7.42E+08			
90Sr	5.77E+06				5.81E+06				9.60E+06			
99Tc	6.72E+05				6.66E+05				5.07E+05			
60Co	2.06E+03				2.01E+03				2.68E+03			
154Eu + 155Eu	6.51E+04				6.35E+04				9.81E+04			
From Spec 7.2.2.1	mol/L											
Na	6.99				6.99				8.32			
		A				A				A		
		Y	Y	Y		Y	Y	Y		Y	Y	Y
		0	0	0		0	0	0		0	0	0
		0	0	0		0	0	0		0	0	0
		4	2	3		4	2	3		4	2	3

The waste in tank 241-AN-107 (Batch 7) is not projected to meet the feed specification (Envelope C) due to high TRU and $^{154/155}$Eu. A large ^{155}Eu detection limit for the liquid was originally included in the calculation of the solid layer ^{155}Eu concentration from the centrifuged solid and liquid data. This caused high ^{155}Eu value and is not expected to be high. During the certification process, analysis should be performed to verify that the TRU does not meet the feed specification and $^{154/155}$Eu does meet the feed specification. If the waste is treatable within the facility, a price for processing the out of specification feed should be negotiated (RL 1996).

The second batch from 241-AN-104 is projected to meet the feed specifications. However, decanting the supernate from tank 241-AN-104 leaves settled solids that are high in sulfate. The diluted supernate will be returned and mixed multiple times with saltcake left in tank 241-AN-104 to ensure Envelope A feed.

The batch from tank 241-S-102 (mixture of 241-S-102, -103, and -105) is not classified as belonging to any envelope because of the high PO_4 concentration. Transferring wastes from 241-S-102, -103, and -105 as soon as the retrieval systems are operational for each tank will provide additional time to negotiate a price for processing the out-of-specification feed (RL 1996), if needed.

There is a risk that WFD may not consistently be able to deliver waste that meets Envelopes A, B, or C feed requirements as required by Specification 7 of the BNFL Inc. contract. Refinement of component partition factors between liquid and solid phases used for retrieval modeling is necessary to confirm the extent to which the composition of the retrieved waste is out of specification.

While clause H.43 in the BNFL Inc. contract (RL 1996) provides some latitude for processing out of specification waste, it does not remove the risk of a rejected feed batch. Clause H.43 states that if (1) the waste can technically be processed and (2) the waste complies with facility permits and (3) the waste falls within BNFL Inc.'s facility safety authorization basis, then a treatment price will be negotiated based on incremental effects on BNFL Inc. costs and processing rates.

The DOE Waste Disposal Division planning guidance (PIO 2000) contains the following statement: "Assume that delivered LAW and HLW feed is within the BNFL Inc. facility permits and safety authorization basis; therefore, no feed blending or adjustments are required" (Section 3.3.1,[1] p. 15). So clause H.43 by itself does not remove any risk from delivery of tank waste out of specification. There are no specific criteria written for the assumption stated above. Nor are estimates available for the size of the incremental cost impacts as discussed in the previous paragraph.

The LAW feed specifications should be modified so that the delivered LAW feed composition meets contract specifications. Specification 7 in the BNFL contract should be modified so that all Hanford tank farm waste, when retrieved to a staging tank, falls within component specifications.

3.2 TANK-SPECIFIC STAGING STRATEGY, EQUIPMENT, AND SCHEDULE

3.2.1 Tank-Specific Staging Plan

The DOE-ORP provided guidance (PIO 2000) for the sequence of source tanks to be used to provide LAW feed to BNFL Inc. That guidance is based on the following assumptions.

– Waste from tank 241-AP-101 is processed first.

– Pretreated Envelope B waste

  - Pretreated waste is processed as the second batch.

  - Pretreated waste is not returned to CHG.

– Tanks 241-AN-101 and -102, and 241-AP-104 used as staging tanks. Tank 241-AP-102 is used as a backup staging tank. Other tanks are to be used as staging tanks as they become available.

– Entrained solids are stored in BNFL facility.

– Stage tanks that are easier to retrieve early.

– Avoid moving onto a subsequent feed tank when only a small amount is remaining in the current tank (tank-hopping). Finish emptying each DST promptly.

– Simplify Projects W-211 and W-521design and construction activities by grouping tanks from the same farm together.

The tank-staging plan was reviewed for consistency with the above criteria; deviations from the above criteria were made when appropriate. These deviations are discussed below. See Appendix I, Figure I-1, for the LAW feed staging and delivery schedule. Appendix H contains a table showing the detailed transfer from the feed batches. Appendix A, Table A-17, contains detailed proposed staging actions, process issues, and equipment considerations. The operational need dates also are included in this table.

As shown in Section 3.1, for Minimum Order Case, six tanks (241-AP-101, 241-AW-101, 241-SY-101, 241-AN-103, -104 and -105) contain Envelope A feed, two tanks (241-AN-102 and 241-AN-107) contain Envelope C feed; and BNFL Inc.'s tank (holding pretreated 241-AZ-101 and 241-AZ-102 tank waste) contains pretreated Envelope B feed for Case 3S6E. All of these feeds must be used towards the minimum order quantity to satisfy the 6,000 unit requirement in the contract (RL 1996). All of Envelope A feeds, with the exception of that from tank 241-AP-101, are on the watch list for flammable gas concerns. Transfer of waste from a hydrogen/flammable gas tank requires written approval by Nuclear Safety and DOE. This is a self-imposed requirement contained in the Operating Specification Document (OSD). It is not required by law or by the authorization basis. On the other hand, transfer of waste *into* a watch-list tank requires written approval by the Secretary of Energy (OSD-T-151-00030, CHG 1999). It is important that all actions needed to obtain these approvals be completed well in advance of the planned transfer dates (these actions are identified on the Mid-Level Logic Diagrams [Diediker 2000]).

For this case, the following sequence will be used.

The first tank waste was selected from tank 241-AP-101. This tank contains only supernate, classified as Envelope A waste. The waste in the tank is assumed to be retrievable without any modification to the tank or existing pump. Tank 241-AP-101 was chosen to be the first tank to support potential LAW hot operations in April 2006, one-and-a-half years before the target schedule date stipulated in BNFL Inc. contract per direction from the PIO.

The second batch of LAW feed will be the supernate from tanks 241-AZ-101 and 241-AZ-102, which contain Envelope B waste (the neutralized current acid waste [NCAW] supernate). Wastes from these tanks are delivered early to support HLW feed processing. These wastes are processed early to alleviate the absence of BNFL Inc.'s tank space for storage of the pretreated waste. The waste from tanks 241-AZ-101 and 241-AZ-102 will be delivered as a slurry. BNFL Inc. will separate the supernate from the solids, pretreat the liquids, and vitrify the pretreated liquid. Details on the delivery of the contents of those tanks are discussed in Section 4.2.

The third and fourth batches delivered to BNFL Inc. will be Envelope C waste from tank 241-AN-102. Envelope C represents waste with high SO_4, ^{60}Co, ^{90}Sr, $^{154,155}Eu$ and/or TRU contents that will be segregated and removed (except SO_4) to blend with HLW to be treated as HLW. Therefore, Envelope C waste must be treated near the beginning of the process to ensure that segregated Envelope C waste is vitrified before the completion of the HLW vitrification. Furthermore, this tank is needed as a staging tank for other LAW waste. Caustic addition is required to bring this waste to within the tank farm corrosion specifications. The feed batches from tank 241-AN-102 will be delivered to BNFL Inc. after they have processed enough Envelope B (Batch 2) to make enough room to receive Batch 3 in BNFL Inc.'s facility.

Tank 241-AN-104 was selected as the fourth tank for Case 3S6E. Tanks 241-AN-105 and 241-AW-101 are good candidates also. Tank 241-AW-101 was skipped to permit Project W-211 to obtain design and construction efficiencies by upgrading two tanks in the AN Tank Farm, tanks 241-AN-105 and 241-AN-104, on a similar schedule. Once its waste has been retrieved, this tank is needed as the slurry cross-site receiver tank. Therefore, the second portion of the waste will be delivered to BNFL Inc. first while the first batch will be staged in tank 241-AN-101. The first staged waste is projected to meet the feed specifications; however, the second batch from 241-AN-104 is not projected to meet the feed specifications. Present retrieval plans call for decanting the supernate from tank 241-AN-104 and preventing a gas-release event, leaving settled solids that are high in sulfate. The liquid feed produced by dissolution of those solids is outside the sulfate limit in the feed specifications. Decanting the supernate to prevent gas release, returning the supernate to tank 241-AN-104, and mixing the waste to recover all of the tank waste should alleviate the high sulfate problem. Staging 241-AN-104 early (before processing begins) will provide additional time to negotiate a price for processing the out-of-specification feed, if needed. The waste from this tank will be Batches 5 and 6.

The fifth tank quantity of waste delivered to BNFL Inc. will be Envelope C waste, by default from tank 241-AN-107. Caustic addition is required to bring this waste to within tank farm corrosion specifications. The waste in tank 241-AN-107 (Batch 7) is not projected to meet the feed specification (Envelope C) because of high TRU and $^{154/155}Eu$ content. A large ^{155}Eu detection limit for the liquid originally was included in the calculation of the ^{155}Eu concentration in the solid layer from the centrifuged solid and liquid data. The use of a high value in the calculation resulted in a higher ^{155}Eu content than is really expected. During the certification process, analysis should be performed to verify that the TRU does not meet the feed specification and the $^{154/155}Eu$ does meet the feed specification. If the waste is treatable within the facility, a price for processing the out-of-specification feed should be negotiated (RL 1996). The waste from this tank will be Batch 7.

The sixth quantity of tank waste was selected from tank 241-AN-105. Once the waste has been retrieved, this tank will be used as a staging tank as needed. Tank 241-AN-105 contains waste that is within 20 percent of the sulfate envelope limit. The waste from this tank will be Batches 8 and 9.

The seventh quantity of tank waste was selected from tank 241-SY-101. This batch is pre-staged in 241-AP-104 and was delivered earlier to accommodate the mitigation of level growth. Waste from 241-SY-101 was transferred to 241-SY-102 containing SWL, and then transferred via the cross-site system to 241-AP-104. The amount of waste estimated for transfer from tank 241-SY-101 to tank 241-SY-102 by the HTWOS model (1,140 m^3 [300,000 gal]) was based on preliminary planning information and is lower than the actual amount of waste transferred (1,990 m3 [500,000 gal]). Future modeling efforts will include actual amounts of waste transferred. This batch is expected to be an Envelope A feed. The second batch from tank 241-SY-101, which is Envelope A waste, will be transferred to 241-SY-102 and then transferred via the cross-site system to 241-AN-101. The waste from this tank will be Batches 10 and 11.

The eighth tank selected for waste removal was tank 241-AN-103. The waste in it may be the most difficult to retrieve since it is the most concentrated of the five Envelope A wastes (it contains double-shell slurry [DSS]; the others contain only double-shell slurry feed [DSSF]). The crust may complicate retrieval operations. Once the waste has been retrieved, this tank could be used as a staging tank as needed. The waste from this tank will be Batches 12 and 13.

The Envelope A feed for the last Minimum Order tank will come from tank 241-AW-101, the ninth tank selected. This tank will supply the first feed for the Extended Order tank if not used as the feed for the Minimum Order. The waste from this tank will be Batches 14 and 15.

The tenth tank selected for waste removal is tank 241-AW-104, which contains Envelope A waste. Only the liquid portion of the waste in tank 241-AW-104 will be used for LAW feed. The sludge portion will be supplied as HLW feed. The waste from this tank will be Batch 16.

The eleventh tank selected for waste removal is tank 241-SY-103, which contains Envelope A waste. Only the supernate portion of the waste in tank 241-SY-103 will be used for LAW feed. The waste from this tank will be Batch 17.

The twelfth tank selected for waste removal is tank 241-AP-106, which contains saltwell liquor from the SST stabilization program that is classified as Envelope A waste. The waste from this tank will be Batches 18 and 19.

The waste from tanks 241-S-102, -103 and –105 are blended and are identified as the waste from the thirteenth tank, tank 241-S-102. Only the soluble portion of the waste from these tanks will be used for LAW feed. The blended waste will be stored in the staging tank 241-AP-101. The blended waste in the tank is not classified as belonging to any envelope because of its high PO4. Transferring wastes from 241-S-102, -103, and -105 as soon as the retrieval systems are operational for each tank will provide additional time to sample the staged waste, identify any out-of-specification conditions, and to negotiate a price for processing the out-of-specification feed, if needed. The waste from tank 241-S-102 will first be transferred into tank 241-SY-103 where it will be mixed with waste either from tank 241-S-103 or -105; this activity will be followed by cross-site transfer into tank 241-AN-104, and finally into tank 241-AP-101 for staging. The waste from these tanks (241-S-102, -103 and –105) will be labeled Batch 20.

The waste from tanks 241-S-105, -106 and –108 are blended and are identified as the waste from the fourteenth tank, tank 241-S-105. Only the soluble portion of the waste from these tanks will be used for LAW feed. The blended waste will be stored in the staging tank 241-AN-105. The blended waste in the tank is classified as envelope C waste. The waste from tank 241-S-105 will first be transferred into tank 241-SY-103 where it will be mixed with waste from tank 241-S-106; this activity will be followed by cross-site transfer into tank 241-AN-104, and finally into tank 241-AN-105 for staging. The waste from tank 241-S-106 will first be transferred into tank 241-SY-103 where it will be mixed with waste from tank 241-S-108; this activity will be followed by cross-site transfer into tank 241-AN-104, and finally into tank 241-AN-105 for staging. The waste from these tanks (241-S-105, -106 and –108) will be labeled Batch 21.

The fifteenth tank selected for waste removal is tank 241-AP-105, which contains saltwell liquor from the SST stabilization program; this waste is classified as Envelope A waste. Tank 241-AP-104 will be used as the staging tank. The waste from this tank will be Batches 22 and 23.

The last tank selected for Extended Order processing is tank 241-AP-108, which contains saltwell liquor from the SST stabilization program; this waste is classified as Envelope A waste. The waste from this tank will be Batch 24. This information is summarized in Table 3.2-1.

Table 3.2-1. Low-Activity Waste Feed Preparation. (8 Sheets)

Source tank	Staging tank	Proposed staging actions	Process considerations	Equipment considerations
AP-101	AP-101	• Grab sample to certify supernate • Transfer to BNFL Inc. with in-line dilution if needed	• Waste from AP-101 should not need dilution to transfer to BNFL Inc.	• Has operational Flexi-float pump • W-522 replaces so it works in 2015 Ready date April 2004 Op need date August 2005 • Ability to transfer from AP-101 to BNFL Inc. (need pump upgrade?) • Replacement pump has dilution water piped to the suction inlet
AZ-101	AZ-101	• Deliver supernate with HLW solids (see Table 4.2-1)	• See Table 4.2-1	• See Table 4.2-1
AZ-102	AZ-102	• Deliver supernate with HLW solids (see Table 4.2-1)	• See Table 4.2-1	• See Table 4.2-1
AN-102	AN-102	• Caustic Addition (0.5*M*) within available freeboard • Mix contents • Settle solids • Sample and certify supernate • Decant and deliver to BNFL Inc. with in-line dilution • Clean out heel to AP-107 with 530 m^3 (140.4 kgal) of wash water.	• Room available for NaOH needed to meet corrosion spec.? (303 m^3 [80 kgal] of freeboard now) • What is the plan for caustic addition? (assumed 10/1/2001) • Deliver as 2 batches (keep the decant step and flush cleanout) • Move residual (clean out) to AP-107 • How clean does it need to be for staging tank use? • No firm agreement in place for BNFL to process entrained solids • Alternate adjustment and dilution could send all AN-102 waste to BNFL • The actual sludge volume in the tank may be higher. • Eliminate need to clean out solids heel • May still need a flush of the tank because of Envelope change • Need to dilute more to dissolve $NaCO_3$ • Sodium carbonate precipitation not a serious issue below 2*M* Na OH	• Alternative Generation and Analysis (AGA) in progress • What equipment do we need? - should only need one mixing or agitation device - destination of solids may drive transfer pump selection - need decant pump for later use as staging tank • AN-102 may not be suitable for use as staging tank because of past corrosion • May need "Fitness of Use" evaluation for use as staging tank • Elimination of decant step may save operations dollars by getting rid of decant pump and subsequent replacements (better overall to send all solids to BNFL) • W-211 to install retrieval system Ready Date May 2006 Op Need Date June 2007

Table 3.2-1. Low-Activity Waste Feed Preparation. (8 Sheets)

Source tank	Staging tank	Proposed staging actions	Process considerations	Equipment considerations
AN-104	AN-101 (supernate) AN-104 (dissolved solids)	• Decant supernate to AN-101 with in-line dilution. • Install mixer pumps (by sluicing). • Transfer 1,140 m^3 (300 kgal) of diluted supernate from AN-101 to AN-104. • Mix the waste and allow solids to settle. • Decant 1,140 m^3 (300 kgal) from AN-104 to AN-101. • Mix the waste in AN-101. • Sample both AN-101 and AN-104 for Na and SO_4 • Add water to each tank to dilute Na to 7*M* - 715 m^3 (189 kgal) H_2O to AN-101 - 416 m^3 (110 kgal) H_2O to AN-104 • Transfer 1,140 m^3 (300 kgal) from AN-101 to AN-104 • Mix the waste in AN-104 and allow solids to settle • Transfer 1,140 m^3 (300 kgal) from AN-104 to AN-101 • Mix the waste in AN-101 • Transfer 1,140 m^3 (300 kgal) from AN-101 to AN-104 • Mix the waste in AN-104 and allow solids to settle • Sample AN-104 to see if SO_4 is within specification • If within specification, sample both AN-101 and AN-104 to certify • Decant AN-104 to deliver to BNFL Inc. • Transfer AN-101 to deliver to BNFL Inc. • Remove solids heel from AN-104 using SY-102 supernate and transfer to AZ-101 (clean out for subsequent use)	• Would like to sample while settling to be able to see what solids are. May be able to send undissolved solids rather than letting settle and decanting. • Degassing occurs by decanting supernate • Use as cross-site receiver may cause problems for use as backup staging tank (heels). • High SO_4 in dissolved solids part (adjust retrieval volumes to fix). • Preliminary calculations show that 3 to 6 transfers are needed to blend SO_4 • Assume 6 transfers as planning basis until tank-specific flowsheet confirms ability to blend SO_4 with 3 transfers • HTWOS only needed to add 1,874 m^3 (495 kgal) of water to dissolve solids and dilute waste to 7*M*.	• Need mixer pump and decant pump • May have problem inserting mixer into settled solids; sluice into place • Existing transfer pump won't do the needed job. • Junk equipment (sampling debris); will its presence cause mixing problems or damage equipment? • Another east area cross-site receiver is needed • W-211 will replace that pump March 2004 (turnover) Op need date Dec. 2004 - Transfer back and forth between DST's to dilute SO_4 - Certify feed in both DST's to send to BNFL • Proposed staging actions implement Interim Guidance provided by Russ Treat, June 21, 1999. • <u>Interim Guidance</u> - Use AN-104 to demonstrate degassing - Install outside-of-tank equipment. - Sluice in decant pump per degassing constraints - Decant supernate (with in-line dilution) - Install mixer pump into solids with sluicing (1 to 2 days/pump) - Add dissolution H_2O, mix to dissolve, and settle - Transfer back and forth between DSTs to dilute SO_4 - Certify feed in both DSTs to send to BNFL Inc.

Table 3.2-1. Low-Activity Waste Feed Preparation. (8 Sheets)

Source tank	Staging tank	Proposed staging actions	Process considerations	Equipment considerations
AN-107	AN-107	• Caustic addition (0.5*M*) within available freeboard • Mix contents • Settle solids • Sample and certify supernate • Decant and deliver to BNFL Inc.	• Is room available for NaOH needed to meet corrosion spec.? (363 m^3 [96 kgal] of freeboard now) • What is the schedule for caustic addition? (assumed 10/1/2001) • $NaCO_3$ precipitation after NaOH added – will solids settle? – Still meet spec.? • How close to settled solids can we decant? (25 cm [10 in.] above current solids layer – same in AN-102) • How long to settle the solids? • Final solids density after settling • No use restrictions on tank after retrieval for feed delivery. • Env. C - Out of specification • Deliver as 1 batch (in-line dilution, if necessary) • Doing detailed calculations for AN-107 - May get more feed, could make 2 batches - May need additional dilution to deliver	• AGA in progress • What equipment do we need? - should only need 1 mixing or agitation device (who will confirm?, 2/7-AN AGA. • Sludge weight in bottom—potential for pump damage if there is a cable - Assume not a problem for staging • W-521 to install retrieval system Ready date July 2008 Op need date April 2009
AN-105	AN-102 (supernate) AN-105 (dissolved solids)	• Remove supernate to AN-102 (Degas by decanting) • In-line dilute as transferred • Certify in AN-102 • Install mixer pump • Add H_2O to slurry (left in AN-105) • Mix to dissolve salts • Settle solids • Certify new supernate in AN-105 • Decant supernate and deliver to BNFL Inc.	• Sample while settling to determine what solids are. May be able to send undissolved solids rather than letting settle and decanting. • May need to blend supernate and dissolved solids to dilute SO_4 (feed from dissolved solids is just under the SO_4 limit.)	• Need mixer pump and decant pump • May have problem inserting mixer into settled solids • Existing transfer pump won't do the needed job. • W-211 will replace that pump Ready date August 2009 Op need date October 2009 • Latest project plan (interim guidance provided in late July) - Install outside-of-tank equipment. - Sluice in decant pump per degassing constraints - Decant supernate (with in-line dilution) - Install mixer pump into solids with sluicing (1 to 2 days/pump) - Add dissolution H_2O, mix to dissolve, and settle - Certify feed in both DSTs to send to BNFL

Table 3.2-1. Low-Activity Waste Feed Preparation. (8 Sheets)

Source tank	Staging tank	Proposed staging actions	Process considerations	Equipment considerations
SY-101	AP-104	Initial mitigation retrieval • 339 m^3 (89.5 kgal) to SY-102 with 318 m^3 (84 kgal) of diluent (H_2O) • Add 235 m^3 (62 kgal) of H_2O to SY-101 • Mix SY-101 (1st retrieval gets mixed with saltwell liquor (SWL) in SY-102, SY-102 will go to AP-104)	• Combining 1st retrieval with SWL in SY-102 could turn waste into Env. C. • Homogeneity problem in SY-102 (impact of transfer line routing decision) • Transfer through SY-102 introduces significant risk.	• Has mixer pump and transfer pump (to support retrieval and back dilutions) • SY farm needs transfer lines upgraded (now non-compliant), vent system upgraded, and retrieval equipment installed • Not sure which project upgrades lines and vent system • W-521 puts in retrieval and transfer equipment for transfers to AN-101 Ready date Aug. 2010 Op. need date November 2010 • Assume transfer line problems and vent system problems are fixed or don't limit ability to retrieve and stage for delivery. • No data available to team to model the effect of line and vent system problems in HTWOS • May want to configure SY-101 for cross-site transfers • 2nd SY-101 batch could be retrieved ~1 year earlier than now shown if the SY valve pit is configured to allow use of all SY tanks for cross-site transfers (after SY-101 installation work is done)
	AP-104	Second Mitigation • Retrieve approximately 908 m^3 (240 kgal) to SY-102 to AP-104 with 750 m^3 (198 kgal) H_2O in-line dilution • Certify waste in AP-104 for delivery to BNFL Inc. • Add H_2O to SY-101 to replace volume removed • Mix SY-101		
	AN-101	• Decant to SY-101 supernate to SY-102 then transfer to AN-101 • Certify stage for delivery (post W-521 upgrade)		
AN-103	AN-102 (supernate) AN-103 (dissolved solids)	• Remove supernate to AN-102 (Degas by decanting) • In-line dilute as transferred • Certify in AN-102 • Add H_2O to slurry (left in AN-103) • Mix to dissolve salts • Settle solids • Certify new supernate in AN-103 • Decant supernate and deliver to BNFL	• Sample while settling to determine what solids are. May be able to send undissolved solids rather than letting settle and decanting.	• Need mixer pump and decant pump • May have problem inserting mixer into settled solids • Existing transfer pump won't do the needed job. • W-211 will replace that pump Ready date February 2011 Op need date May 2011 • Latest project plan (interim guidance provided in late July 1999) - Install outside-of-tank equipment. - Sluice in decant pump per degassing constraints - Decant supernate (with in-line dilution) - Install mixer pump into solids with sluicing (1 to 2 days/pump) - Add dissolution H_2O, mix to dissolve, and settle - Certify feed in both DSTs to send to BNFL • Assume AN-104 experience allows mixer pump installation before supernate decant step. Project schedules are being adjusted to provide time for two-stage equipment installation if necessary.

Table 3.2-1. Low-Activity Waste Feed Preparation. (8 Sheets)

Source tank	Staging tank	Proposed staging actions	Process considerations	Equipment considerations
AW-101	AN-105 (supernate) AW-101 (dissolved solids)	• Remove supernate to AN-105 (Degas by decanting) • In-line dilute as transferred • Certify in AN-105 • Add H_2O to slurry (left in AW-101) • Mix to dissolve salts • Settle solids • Certify in AW-101 • Decant and deliver to BNFL Inc.	• Sample while settling to determine what solids are. May be able to send undissolved solids rather than letting settle and decanting. • Failed pump in AW-101 may interfere with mixing.	• Need mixer pump and decant pump in AW-101 • May have problem inserting mixer into settled solids • Existing transfer pump won't do the needed job. • W-211 will replace AW-101 pump Ready date February 2012 Op need date March 2012 • Latest project plan (interim guidance provided in late July 1999) - Install outside-of-tank equipment. - Sluice in decant pump per degassing constraints - Decant supernate (with in-line dilution) - Install mixer pump into solids with sluicing (1 to 2 days/pump) - Add dissolution H_2O, mix to dissolve, and settle • Certify feed in both DSTs to send to BNFL Inc.
AW-104 (supernate)	AP-104	• Decant to evaporator feed tank • Concentrate and return waste to AW-104 (combines with some SWL in the Evaporator) • In-line dilute to transfer • Certify in AP-104 • Transfer supernate to BNFL Inc.	• Tank contains dilute supernate that needs to be concentrated • May have to stage supernate earlier (than needed for LAW feed delivery) to use AW-104 to stage HLW solids or deliver both LAW and HLW together	• Need mixer pump and decant pump • Existing transfer pump has failed • Need to replace transfer pump earlier to stage SWL for concentration in evaporator • Operations will fix existing transfer pump by ~6/20/2001 • W-521 Ready date September 2011 Op need date December 2012
SY-103	AN-101	• Decant supernate to SY-102 (with in-line dilution) • Cross-site supernate to AN-101 • Certify in AN-101 • Transfer to BNFL Inc.	• Need to go through SY-102? (upgrade timing) • Env. A – within specification	• SY-103 has transfer pump (probably failed) • W-521 replaces transfer pump Ready date June 2009 Op. need date November 2012 • Need decant pump for when SST wastes are moved through SY-103 • W-521 should install a dual-function pump • May want to configure SY-103 for cross-site transfers • May need or want mixing device for Phase 2 solids • SY valve pit should have been reconfigured by now (as part of SY-101 work) to allow use of SY-103 for cross-site transfer. • Will transfer pump being put into SY-103 support its use for direct cross-site transfers? Need to look at pump-intake (a.k.a. in-line) dilution requirements also.

Table 3.2-1. Low-Activity Waste Feed Preparation. (8 Sheets)

Source tank	Staging tank	Proposed staging actions	Process considerations	Equipment considerations
AP-106 (concen-trated SWL accumula-tion; all supernate)	AN-102	• Mix supernate (no solids expected) • Transfer ~ ½ to AN-102 with in-line dilution • Certify first ½ in AN-102 • Transfer to BNFL	• Can we qualify the waste in AP-106 and transfer with in-line dilution? • Could use only 1 DST if we do not dilute the waste with water • Receive 265,000 L (70,000 gal) less from AW-106.	• Maintained by Operations to serve as SWL receiver • W-522 upgrades transfer pump for transfer of waste for phase 1B prime feed Ready date Nov. 2013 Op need date Mar. 2014 • Ability to transfer from AP-106 to BNFL Inc. (need pump upgrade?)
	AP-106	• Add H_2O to dilute second ½ • Certify in AP-106 • Transfer to BNFL Inc.		
S-102 (S-103, S-105)	AN-101	• Retrieve into SY-103 (use past-practice sluicing parameters in model; assume retrieval with H_2O) • Dissolve salts in SY-103 heel (SY-103 is receiving several SST wastes at one time; S-103, S-102, and S-105) • <u>Periodically</u> Settle solids, decant supernate, transfer cross-site to an available DST, and transfer to AN-105 through the AN-104 pump pit	• Need to get only salts for LAW feed. Will assume complete SST retrieval of all S-farm waste. • Limit on simultaneous retrievals into one destination tank? • What in SY-103 dissolves? • Latest BBI/Hanlon (1999b) says more OH solids than before. - Terminology: salt solids have been called sludge - The term “sludge” should be reserved for metal hydroxide solids • SST retrieval may require NaOH addition to meet DST corrosion specifications - Especially in low pH, phosphate-containing wastes - BBI not account for OH consumption over time	• AN-101 equipment already in place in AN-101 and maintained by Operations. • May have failed pump in bottom of SY-103 - Problems with mixing - Tank damage by fluid moving the failed pump? • W-523 (S-102) Ready date July 2012 Op need date February 2013
S-105 (S-106, S-108)	AN-101	• Retrieve into SY-103 (use past-practice sluicing parameters in model; assume retrieval with H_2O) • <u>Periodically</u> Settle solids, decant supernate, transfer cross-site to AN-104 and then to AW-101 • SY-103 is receiving several SST wastes at one time (S-105, S-106, and S-108)	• Need to get only salts for LAW feed. Will assume complete SST retrieval of all S-farm waste. • Limit on simultaneous retrievals into one destination tank? - Latest BBI/Hanlon (1999b) says more OH solids than before. Terminology: salt solids have been called sludge • SST retrieval may require NaOH addition to meet DST corrosion specifications.	• Need mixer pump and decant pump in SY-103 • May have failed pump in bottom of SY-103 - Problems with mixing - Tank damage by fluid moving the failed pump? • W-523 Ready date February 2013 Op need date May 2013

Table 3.2-1. Low-Activity Waste Feed Preparation. (8 Sheets)

Source tank	Staging tank	Proposed staging actions	Process considerations	Equipment considerations
AP-105 (concen-trated SWL accumul-ation; all supernate)	AP-104	• Mix supernate (no solids expected) • Transfer ~ ½ to AP-104 with in-line dilution • Certify first ½ in AP-104 • Transfer to BNFL Inc.	• There will be solids that will require a mixer pump to redissolve before feed delivery • Precipitation occurs during the 10 years of storage because of natural evaporation and cooling.	• Existing transfer pump in AP-104 has problems • Assume it will work until W -211 replaces; some risk if SY-101 isn't Env. A; we need to move it on, and pump fails) • Need mixer pump and decant pump • May get by with a stick pump (depends on accumulated solids levels) • W-211 (AP-104) Ready date August 2004 Op need date November 2004 (for use as backup feed)
AP-105 (Continued) (concen-trated SWL accumul-ation; all supernate)	AP-105	• Add H_2O to dilute second ½ • Certify in AP-105 • Transfer to BNFL Inc.	• Ability to transfer from AP-105 to BNFL Inc. (need pump upgrade?)	• Maintained by Operations to serve as concentrated waste receiver (until FY 2000) • W-522 upgrades AP-105 transfer pump Ready date June 2015 Op need date September 2015
AP-108 (concentrated SWL accumula-tion)	AP-108	• Mix supernate (no solids expected) • Certify • Transfer to BNFL Inc.	• There will be solids that will require a mixer pump to redissolve before feed delivery • Precipitation occurs during the 10 years of storage because of natural evaporation and cooling.	• Need new transfer pump and jumpers, and Instrumentaion and Control (I&C) system • W-522 provides upgrades Ready date September 2014 Op need date April 2016

AGA= Alternative generation and analysis
BBI = Best-basis inventory
DST = Double-shell tank
I&C = Instrumentation and control
IWFST = Intermediate Waste Feed Staging Tank
LAW = Low-activity waste
SST = Single-shell tank
SWL = Salt well liquid.

3.2.2 Equipment

Table 3.2-2 summarizes a preliminary assessment of the equipment needed for WFD performed for Case 3S6E. Most of the work is covered by an existing project. The installation of a transfer pump, jumpers, and an instrument and control (I&C) system to tank 241-AP-101 is not scoped or funded under an existing project. Project validations will be completed between FY 2000 and FY 2002. Projects that fall with this category are W-521, W-522, and W-523. Retrieval equipment for 241-AP-101 will be provided and installed by Tank Waste Operations with expense funding.

Other equipment issues still unresolved include primary ventilation for AY/AZ and SY tank farms, toxic gas treatment, and electrical distribution. As formal decisions are made for these issues, the work scope will be assigned to current projects or to a new project yet to be validated.

Implementation of the Extended Order quantity assumes that backup staging tanks would still be required in AP tank farm to support staging of backup feed. W-211 has completed the design and some equipment procurement for these tanks.

Implementing the Extended Order quantities would require the following work scope changes: Tanks 241-AN-101 and -102 would be upgraded with mixer pumps, new waste transfer pumps, jumpers and instrumentation. These upgrades will be required to support use of the tanks as LAW staging tanks.

Table 3.2-2. Equipment Required for Case 3S6E/Phase 1B for Low-Activity Waste.

Tank or project number	Equipment required	Cost (in millions of dollars)
AP-102 & 104 (W-211)[1] • LAW Backup Feed Staging Tanks	• One mixer pump per tank • One transfer pump per tank • Jumpers in central pump pit • I&C system	$21
AP-101 (TBD)[2] • LAW source tank	• One transfer pump plus jumpers • I&C system	$5
AN-101 (W-521) • LAW intermediate waste feed staging tank	• Two mixer pumps (150 hp) • New transfer pump and jumpers • I&C system	$22[3]
AN-102 (W-211)[2] • LAW source tank • LAW intermediate waste feed staging tank	• Two mixer pumps • New Transfer pump and jumpers • I&C system	$15
AN-104 (W-211)[2] • LAW source tank • Intermediate staging tank for cross-site slurry transfers	• Two mixer pumps • New transfer pump and jumpers • I&C system	$17
AN-107 (W-521)[2] • LAW source tank	• New transfer pump and jumpers • I&C system	$17[3]
AN-105 (W-211)[2] • LAW source tank	• Two mixer pumps • New transfer pump and jumpers • I&C system • Chemical addition/dilution system	$18
SY-101 (W-521)[2] • LAW source tank	• Two mixer pumps • New transfer pump and jumpers • Re-jumper SY-A & B valve pit • Replace SN pipelines for SY-101, -102, and –103	$32[3]
AN-103 (W-211)[2] • LAW source tank	• Two mixer pumps • New Transfer pump and jumpers • I&C system	$18
AW-101 (W-521)[2]	• Two mixer pumps • New transfer pump and jumpers • I&C system • Chemical addition/dilution system • Does not include removal of failed submersible pump	$26[3]
AW-104 (W-521)[1] • LAW source tank – supernate retrieval	• Two mixer pumps • New transfer pump and jumpers • I&C system	$28[3]
SY-103 (W-521)[1] • LAW source tank • S Farm receiver tank	• Two mixer pumps • New transfer pump and jumpers • I&C system	$23[3]

Table 3.2-2. Equipment Required for Case 3S6E/Phase 1B for Low-Activity Waste.

Tank or project number	Equipment required	Cost (in millions of dollars)
AP-106 (W-522)[1] • LAW source tank	• One mixer pump • New transfer pump and jumpers • I&C system	$17[3]
S-103 (Expense-funded retrieval Demonstration)	• Salt cake dissolution system, "rain-bird" and dilution water addition system • Waste transfer pump • Pits and jumpers • New pipelines to SY-103	$15[3]
S-102 (W-523)[1] • LAW source tank	• Baseline sluicing and dilution water addition system • Waste transfer pump • Pits and jumpers • New pipelines to SY-103	$83[3]
S-105 (W-523)[1] • LAW source tank	• Baseline sluicing and dilution water addition system • Waste transfer pump • Pits and jumpers • New pipelines to SY-103	$83[3]
AP-105 (W-522)[1] • LAW source tank	• New transfer pump and jumpers • I&C system	$17[3]
AP-108 (W-522)[1] • LAW source tank	• New transfer pump and jumpers • I&C system	$17[3]
W-314 Phase 1	• AN-A & B valve pit jumpers • Reroute Cross-site to AN-101 & 104 • Pipelines from AN-101 to AZ V.P. • New AZ V.P. • Pipelines from AN-104-04A to new AP valve pit provided by W-521 • Pipelines from AZ V. P. to new AP valve pit provided by W-521 • AW-A & B V. P. jumpers • AY pipelines to AZ V.P. • AZ pipelines to AZ V.P. • MPS system	$157
W-314 Phase 2	• AN Tanks 102, 103, 105, 106 & 107 A pit drain seal, SPC & LDE upgrades; new primary HVAC system, plus selected instrumentation, alarm, and electrical upgrades • AP tanks 101, 102, 103, 105, 106, 107, & 108 selected pit drain seal, SPC & LD upgrades; new primary HVAC system, plus selected instrumentation, alarm, and electrical upgrades • AW tanks 101, 102, 103, 105, & 106 selected pit drain seal, SPC & LD upgrades; new primary HVAC system, plus selected instrumentation, alarm, and electrical upgrades • AY Farm selected instrumentation, alarm, and electrical upgrades • AZ Farm selected instrumentation, alarm, and electrical upgrades	$127.8

Table 3.2-2. Equipment Required for Case 3S6E/Phase 1B for Low-Activity Waste.

Tank or project number	Equipment required	Cost (in millions of dollars)
	• SY tanks 101, 102, & 103 selected pits plus SY-A & B valve pit drain seal, SPC & LD upgrades; new annulus HVAC system, plus selected instrumentation, alarm, and electrical upgrades • 244-S pit drain seal, SPC & LD upgrades; **n**ew primary and annulus HVAC system, plus selected instrumentation, alarm, and electrical upgrades	
W-521 (New AP Valve Pit)	• New AP valve pit • Two new pipelines to existing AP V.P. • Upgrade existing AP valve pit jumpers and valve position indication • Tie required instrumentation into W-314 MPS • BNFL Inc. 4 pipelines (LAW & HLW)	$35[3]

HLW = High-level waste
HVAC = Heating, ventilating, and air conditioning
I&C = Instrumentation and control
LAW = Low-activity waste
LDE = Leak Detection Element
MPS = Master Pump System
SPC = Special Protective Coating
[1]Staged backup feed
[2]Minimum order
[3]Cost shown is preconceptual rough-order-of-magnitude estimate. Costs are not validated.

A number of alternative generation and analysis (AGA) studies are under way or planned that address open issues related to DST infrastructure systems. The studies will assess the following systems: electrical power distribution, transfer system valve control/operation, primary ventilation requirements, annulus ventilation of aging-waste tanks, transfer pump design, waste transfer system jumper needs, and sluicing/mixer pump interface at 241-AY-101 and -102.

Table 3.2-2 summarizes equipment needed for WFD during Extended Order of the privatization mission. The identified tanks provide additional waste to meet maximum waste feed quantities as specified in the contract.

3.2.3 Schedules

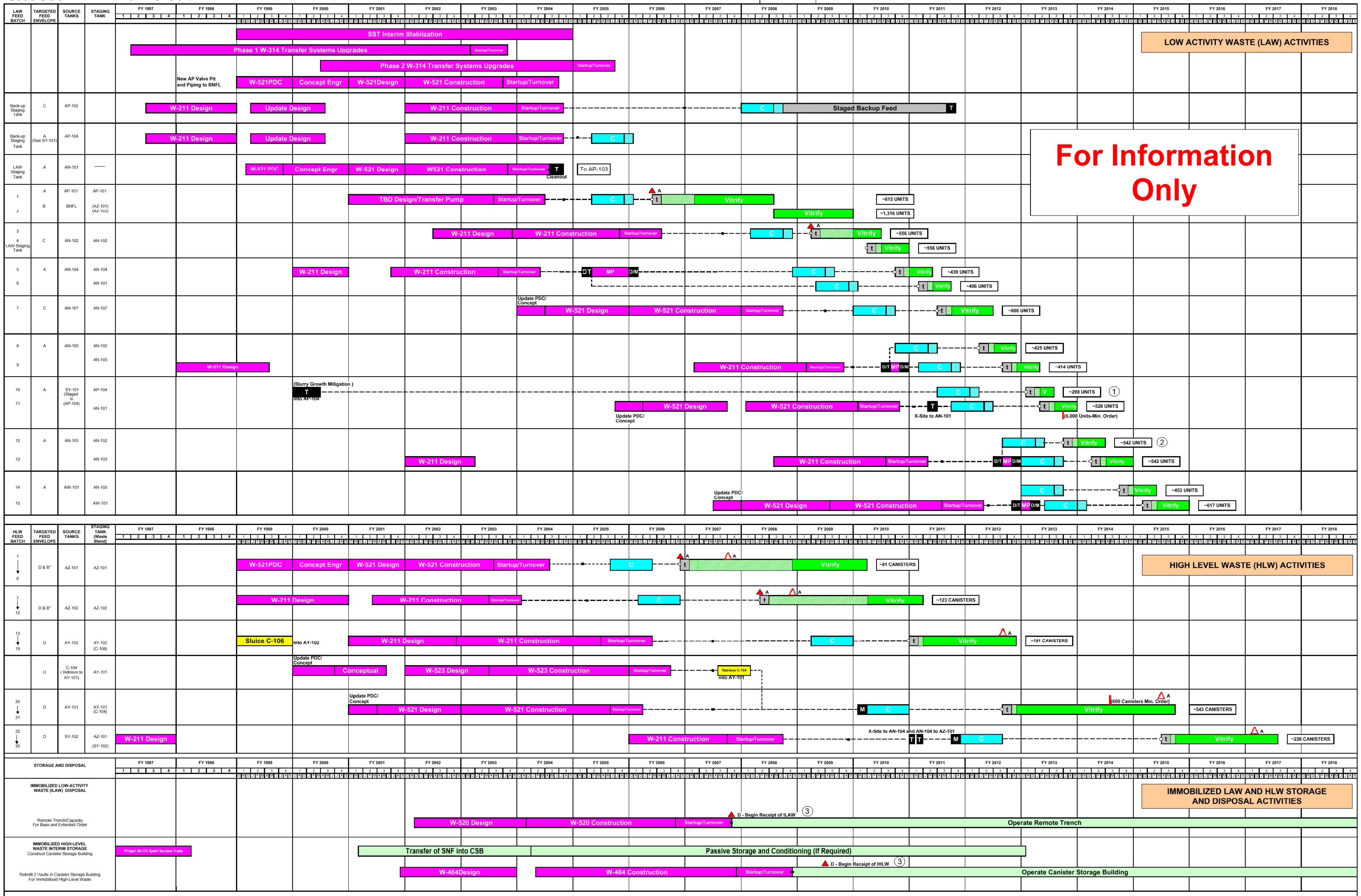
Waste feed delivery schedules for LAW have been established to support continuous BNFL Inc. operations for Case 3S6E at Phase 1 rates between 2000 and 2018. A summary of Phase 1 project operational need dates and proposed construction dates for source and staging tanks is shown in Figures 3.2-1 and 3.2-2. Operation need dates are established by a BNFL Inc. processing schedule calculated from HTWOS modeling with an allowance for time to transfer, blend, and qualify waste as required. Proposed construction dates support transfers, qualification, and delivery of feed, but need to be further coordinated with projects. The coordination with projects is necessary to minimize construction interferences within a tank farm and to improve project Budge Authority/Budget Outlay profiles by minimizing abrupt changes and severe peaks.

3.2.3.1 Mission Summary. Mission summary diagrams for Case 3S6E are shown in Figures 3.2-1 and 3.2-2 for Phase 1B and Phase 1B-Extended Order, respectively. The diagrams summarize the schedule interface between project actions and the need dates driven by the feed staging scenarios. Tanks supporting LAW feed delivery are shown on the upper portion of each figure and HLW tanks are shown on the lower portion. Storage and disposal activities are shown at the bottom of Figure 3.2-2. Magenta-colored bars represent project activities. Blue-colored bars represent tank farm operations and characterization activities. Green-colored bars represent BNFL Inc. processing periods as calculated by the HTWOS model.

This page intentionally left blank.

Figure 3.2-1 Mission Summary Diagram for Case 3S6E - Minimum Order.

Feed Delivery, Storage and Disposal Mission Summary for Case 3S6E R2A



NOTE: See letter 73600-00-001 R.W. Powell for assumptions used in building the mission summary 2006 baseline.
Mission summary for LAW supports a ~2X BNFL ramp-up for vitrification processing.
The mission summary will be evaluated after the BNFL B-1 Contract submittal on 4/24/00.

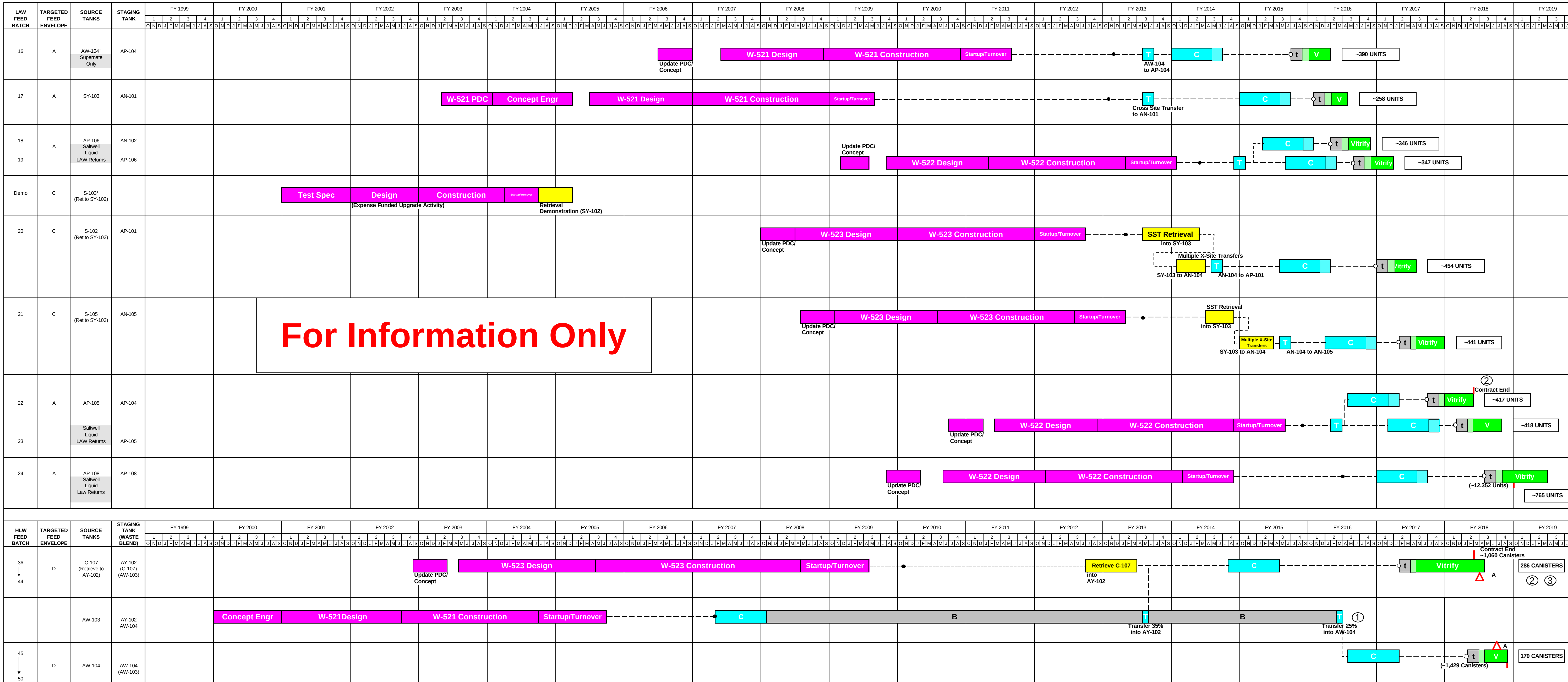
1. SY-101 waste is being certified as backup to AP-101.
If this feed is not used it may require recertification in FY 10 prior to shipment to BNFL.

2. First batch cannot be certified in time to backup batch 10-SY-101.
Delay is because staging tank is not available.

3. CHG projection of dates when BNFL Inc. interim storage reached 50% of capacity.

Figure 3.2-2. Mission Summary Diagram (Extended Order).

Feed Delivery, Storage and Disposal Mission Summary for Case 3S6E R2A, Extended Order



NOTE: See letter 73600-00-001 R.W. Powell for assumptions used in building the mission summary 2006 extended order.
Mission summary for LAW supports a ~2X BNFL ramp-up for vitrification processing .
The mission summary will be evaluated after the BNFL B-1 Contract submittal on 4/24/00.
Mission Summary only addresses WFD transfers. Safe Storage routine waste transfers are not depicted.

1. Percentages of waste from AW-103 transferred AY-102 and AW-104 are to maximize the oxide loading in the blended feed from C-107 and AW-104. 40% remaining will be retrieved in Phase 2

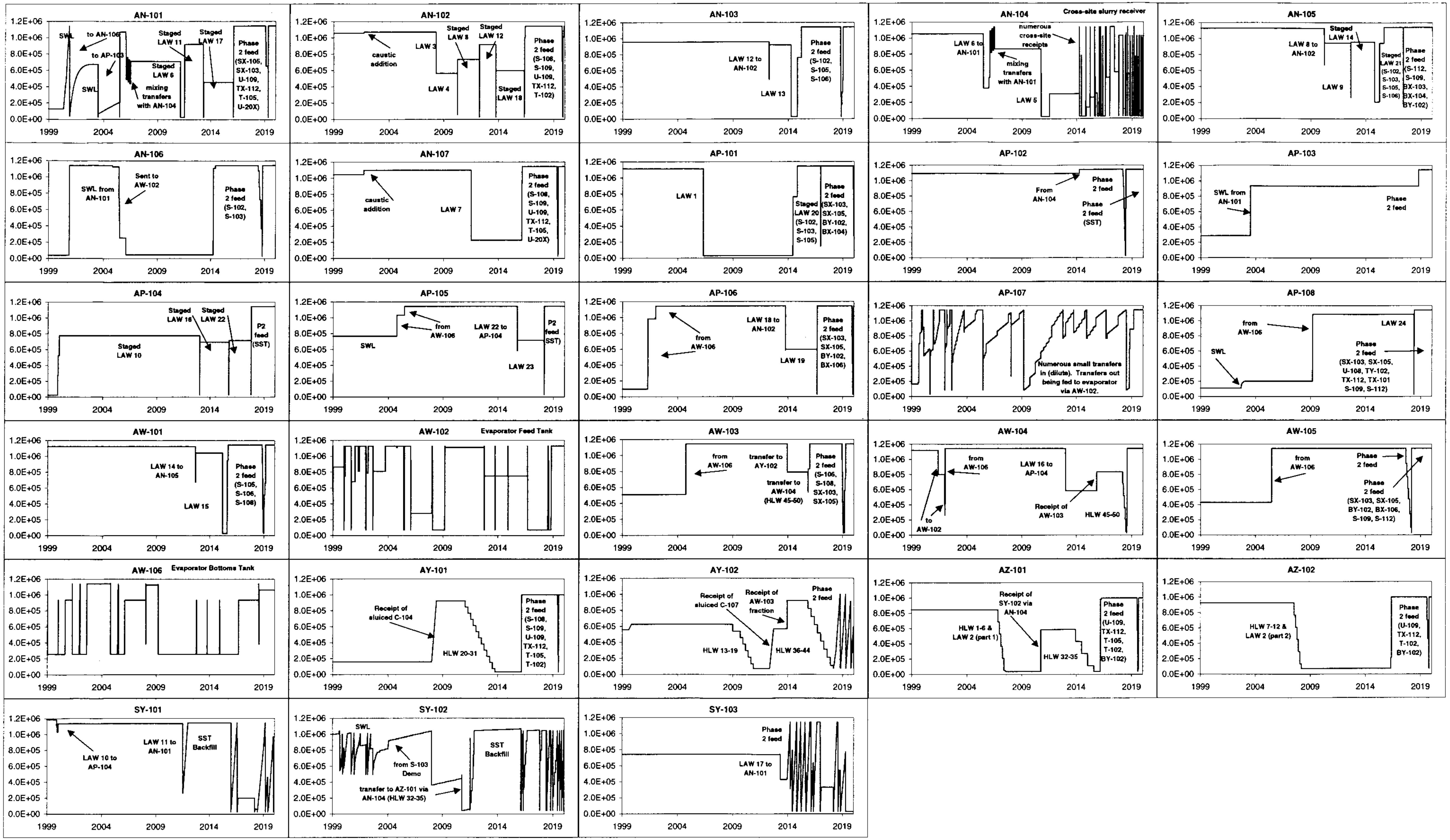
2. Phase 2 processing capacities increase starting March 1, 2018. Derived from BNFL Inc. contract end date of February 28, 2018.

3. Vitrification end dates are based on a Phase 2 HLW capacity of 14 MT IHLW per day (60%TOE) because of insufficient time to add a second HLW plant to the HTWOS model.

U.S. DEPARTMENT OF ENERGY
OFFICE OF RIVER PROTECTION

FEED DELIVERY, STORAGE AND DISPOSAL MISSION SUMMARY FOR CASE 3S6E R2A - EXTENDED ORDER

Figure 3.2-3. Tank Volume Plots for Case 3S6E.



Note: Figure contains transfers for phase 2 HLW.

Backup feed is provided for all LAW and HLW source tanks throughout the minimum order processing. Tank 241-AP-102 provides additional backup LAW feed capability from an independent tank farm should a single-point failure occur between AN tank farm and the new AP valve pit. Tank 241-AW-103 provides additional backup HLW feed capability from an independent tank farm should a single-point failure occur between AZ or AY tank farms and the new AP valve pit.

Figure 3.2.3 shows projected use of DSTs through the end of Phase 1. Notes on the figure indicate all tank-to-tank transfers performed for staging and delivery transfers to BNFL Inc. during Phase 1. Backfilling DSTs near the end of Phase 1 for early Phase 2 feed is also shown on the figure.

3.2.3.2 Coordination of Tank Usage and Construction Activities. Tank usage diagrams for Case 3S6E are shown in Appendix H. The diagrams summarize the schedule interface between project actions and the need dates driven by the feed staging scenarios for each DST. Colored bars are used to represent project, tank farm operations, and characterization activities. Every transfer of more than 189 m^3 (50,000 gal) is shown on the chart, providing the transfer is tank-to-tank or tank-to-BNFL Inc. When multiple transfers occur in the same month, they are moved to the previous month or to the next month depending on the date (transfer order is preserved). For example, five transfers occur in the same month for tank 241-AN-104; they are artificially placed into adjacent months.

3.3 LOW-ACTIVITY WASTE FLOWSHEET

Figure 3.3-1 depicts the interfaces between the CHG and BNFL Inc. The CHG's operations consist of retrieving waste, blending and delivering feed, receiving IHLW for interim storage, and receiving ILAW for disposal. Phase 1 functions performed by the CHG now include the following:

1. Sluicing and/or mixer pump retrieval of sludge from five tanks (sometimes including carrier liquid that is also LAW feed), adjustment of HLW slurry properties (as needed for specification compliance or to facilitate transfers), blending (as needed), and staging of feed batches to BNFL Inc. (Section 4.0).

2. Retrieval of LAW supernate with simultaneous adjustment of properties (as needed), and dissolution of salt slurry followed by retrieval of the dissolates, and staging of feed batches to BNFL Inc. (Section 3.0).

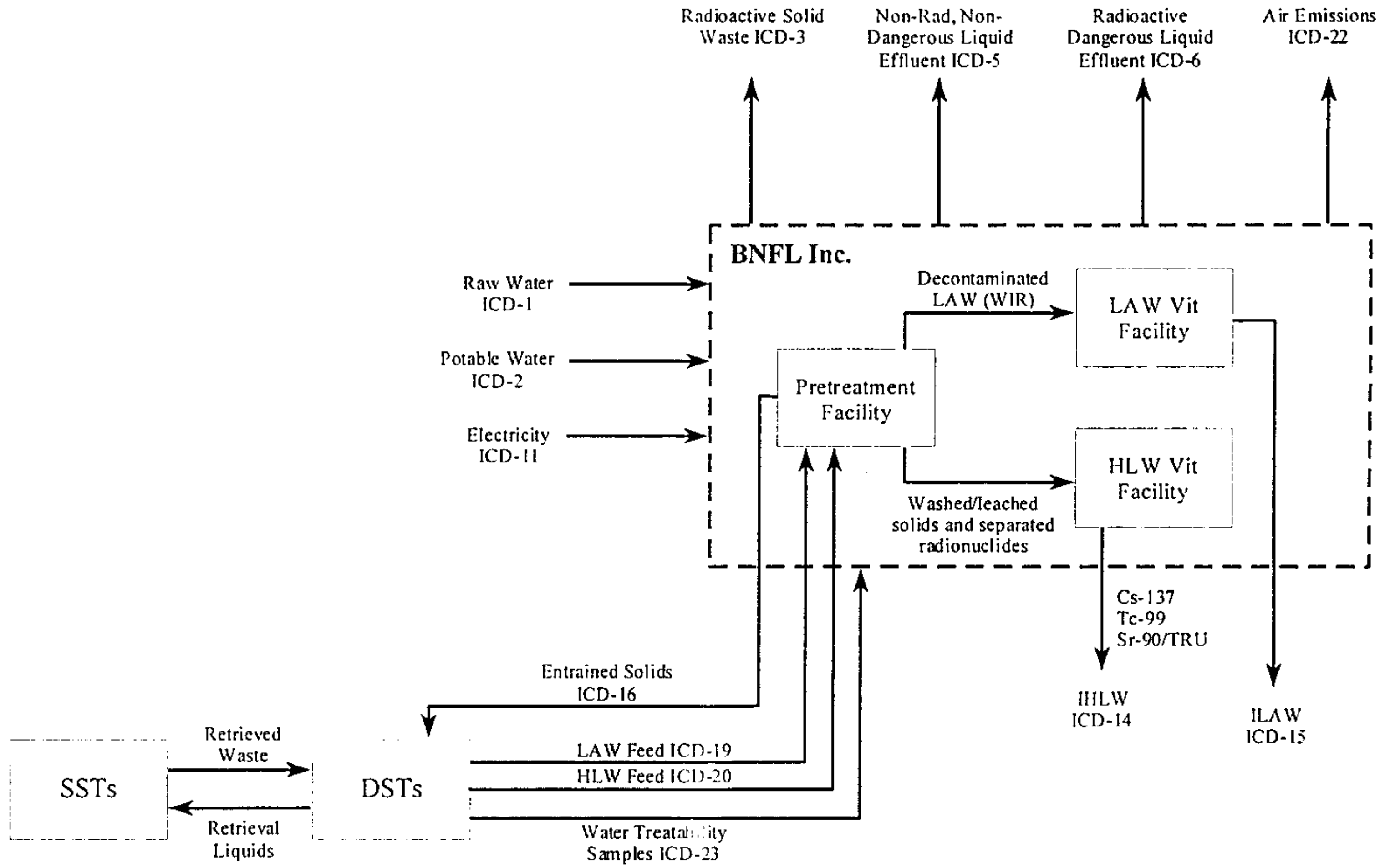
Phase 1 processing by BNFL Inc. includes the following:

1. Pretreatment to recover LAW and HLW fractions from feed materials

2. Vitrification of the LAW fraction and packaging for disposal

3. Vitrification of the HLW fraction and packaging for disposal

Figure 3.3-1. Phase 1 Process Interfaces.



DST = Double-shell tank
HLW = High-level waste
ICD = Interface control document
IHLW = Immobilized high-level waste
ILAW = Immobilized low-activity waste
LAW = Low-activity waste
SST = Single-shell tank
TRU = Transuranic
Vit = Vitrification
WIR = Waste Incidental to Reprocessing (per DOE Order 435.1)

4. Disposal of waste components not vitrified (including components intentionally separated from feed because of incompatibilities with glass; volatile components evolved during vitrification; and large amounts of waste water evolved throughout the process).

The HTWOS model incorporates numerous assumptions pertaining to operations for which BNFL Inc. is responsible. Some assumptions are obtained from BNFL Inc., and some are based on past flowsheeting experience. Key modeling assumptions are discussed in Appendix A. The HTWOS model contains only a simplified flowsheet for retrieval, feed delivery, pretreatment, and vitrification. The preparation of separate, detailed, tank-specific flowsheets began in FY 1999. Flowsheets were prepared for tanks 241-AN-104, 241-AN-105, and 241-AZ-101 (Orme 1999a, 1999b, 1999c). Those flowsheets are being revised in FY 2000, and additional flowsheets are being prepared.

The effort to prepare tank-specific flowsheets is being streamlined by classifying the source tanks according to the similarity of feed delivery steps. Each class is described in the text below, and Figure 3.3-2 identifies which source tanks belong to which flowsheet class.

Class 1 tanks contain LAW liquids and sometimes a sludge layer. Supernate layers are delivered with in-line dilution (as needed). The sludge layer may or may not be Phase 1 feed, so the disposal of the sludge layer varies from tank to tank. A non-feed sludge layer may be left in place. A feed sludge can be either LAW or HLW and is usually blended with some other material before delivery.

Class 2 tanks contain HLW feeds that can be mobilized into a slurry and transferred directly to BNFL Inc. without any blending or preliminary staging transfers.

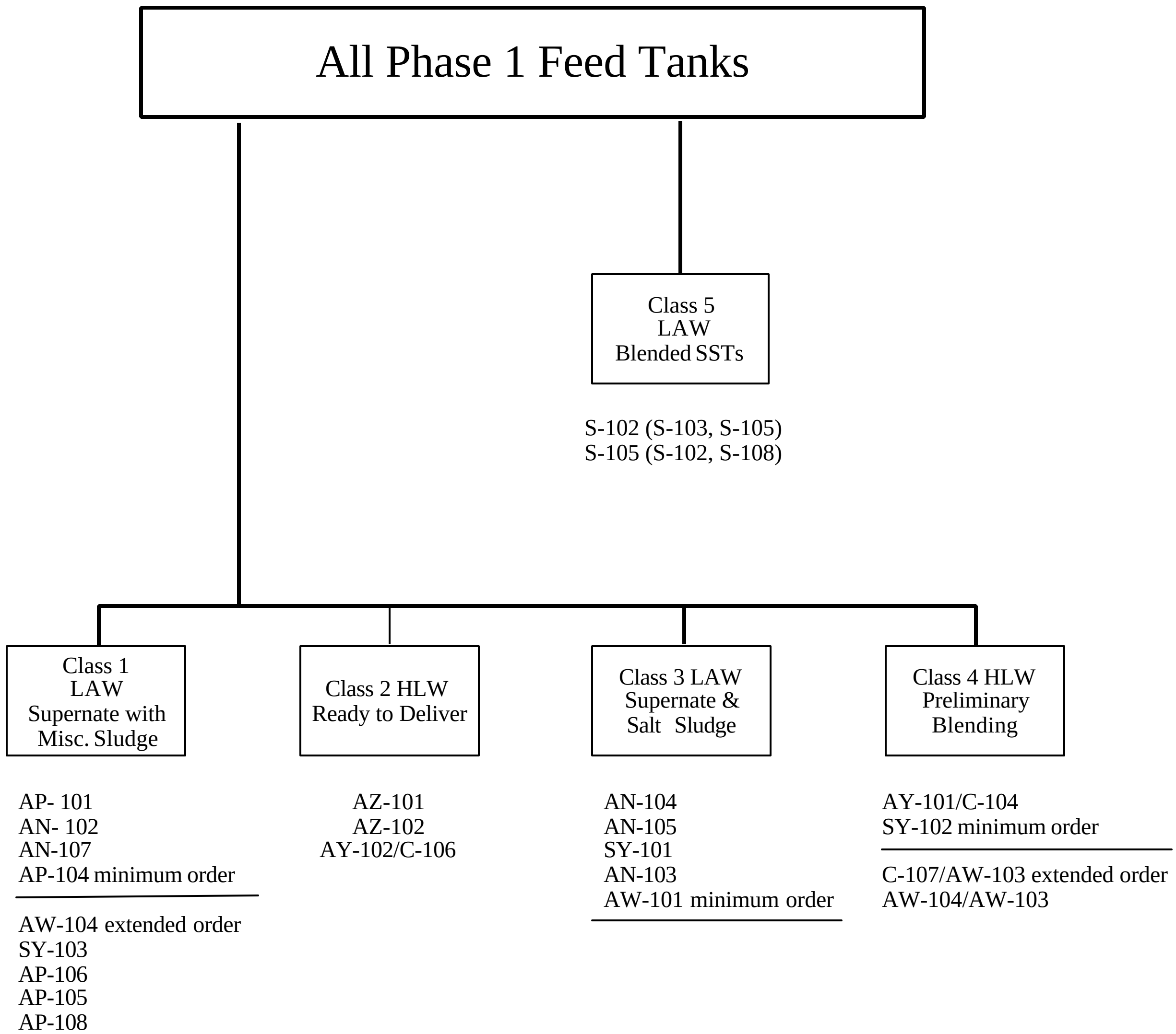
Class 3 tanks contain distinct supernate and salt sludge layers, both layers being LAW feed. The layers are retrieved sequentially. Supernate layers are normally retrieved with in-line dilution into a staging tank. The diluted supernate is certified in the staging tank and delivered to BNFL Inc. Salt sludge is dissolved, mixed with decanted supernate, if necessary, certified in place, and transferred directly to BNFL Inc.

Class 4 tanks contain HLW feeds that need to be blended or moved to a staging tank.

Class 5 tanks contain SST salt sludges that are retrieved into DSTs. Wastes from several source tanks are blended to produce one LAW batch because some SST wastes are being retrieved simultaneously to support the SST retrieval program schedule. The blended LAW liquids are certified in the staging tank and transferred to BNFL Inc.

Figure 3.3-2. Phase 1 Source Tank Flowsheet Classification.

HLW = High-level waste



LAW = Low-activity waste
SST = Single-shell tank

3.4 LOW-ACTIVITY WASTE SENSITIVITIES

The sensitivity of the mission outcome to changes in key technical assumptions was assessed by running the HTWOS model with revised assumptions and comparing the results from the sensitivity cases to the baseline results. The major findings from this sensitivity analysis are summarized below. Results from Case 3S6E are provided in the discussion below as a reference for the comparisons.

Vitrification of LAW feed delivered through the last tank in the minimum order sequence is completed by September 2015 producing a total of 9,830 ILAW packages. The following sensitivities are compared to the planning case:

Vitrification of LAW feed delivered through the last tank in the minimum order sequence is completed by September 2015 producing a total of 9,830 ILAW packages for the planning case 3S6E (March 8 PIO Guidance case). The effect of changes in key assumptions on the ILAW canister count and the completion date for the minimum order quantities are given in Table 3.4-1.

Table 3.4-1. Low-Activity Waste Feed Delivery Sensitivities.

Description	Sensitivity	Ramification
Case 3S6E R2A March 8, 2000 PIO Guidance	This is the results of implementing March 8, 000 PIO guidance (planning case).	None – Produce 9,830 ILAW canister by September 2015 from minimum order feed tanks.
Case 3S6D R7 Sulfate removal	This is the 2006 "hot" start case and CHG delivery system could support BNFL LAW process. Case 3S6D represents a scenario with sulfate removal capacity, therefore, increasing sodium oxide loading (0.195, 0.195, and 0.17 for Envelopes A, B, and C, respectively) thus creating less glass. The ramp-up rate is about 1.8 times slower than Case 3S6E.	Decrease the number of ILAW packages by 1,049 assuming feed from minimum order tanks. A negligible change in the completion date because the slower ramp-up rate is offset by the decrease in the amount of ILAW produced.
Case 3S6C 50% Trend WFD Early start	This case evaluates the CHG plans for 2005 hot start. This case starts LAW delivery 11 months earlier than Case 3S6E.	No changes in number of ILAW packages and accelerate completion of LAW minimum order feed tanks by 11 months.
Case 3S6B R1 Wash Na from HLW Processing	Additional LAW feed is generated from liquids in HLW feed and HLW sludge washing.	Increases number of ILAW packages by 915 and delays completion by nine months relative to the LAW feed from minimum order tanks.

CHG = CH2MHILL Hanford Group, Inc.
HLW = High-level waste
ILAW = Immobilized low-activity waste
LAW = Low-activity waste.